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Nakayama et al.

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(54) **COLLECTION DEVICE AND DETECTION DEVICE**

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A47L 9/14	(2006.01)
G01N 1/04	(2006.01)

(52) **U.S. Cl.**

CPC ***A47L 9/2805*** (2013.01); ***A47L 9/149*** (2013.01); ***A47L 9/2852*** (2013.01); ***G01N 1/04*** (2013.01);

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CPC A47L 9/2805; A47L 9/149; A47L 9/2852; A47L 2201/024; A47L 2201/04;

(Continued)

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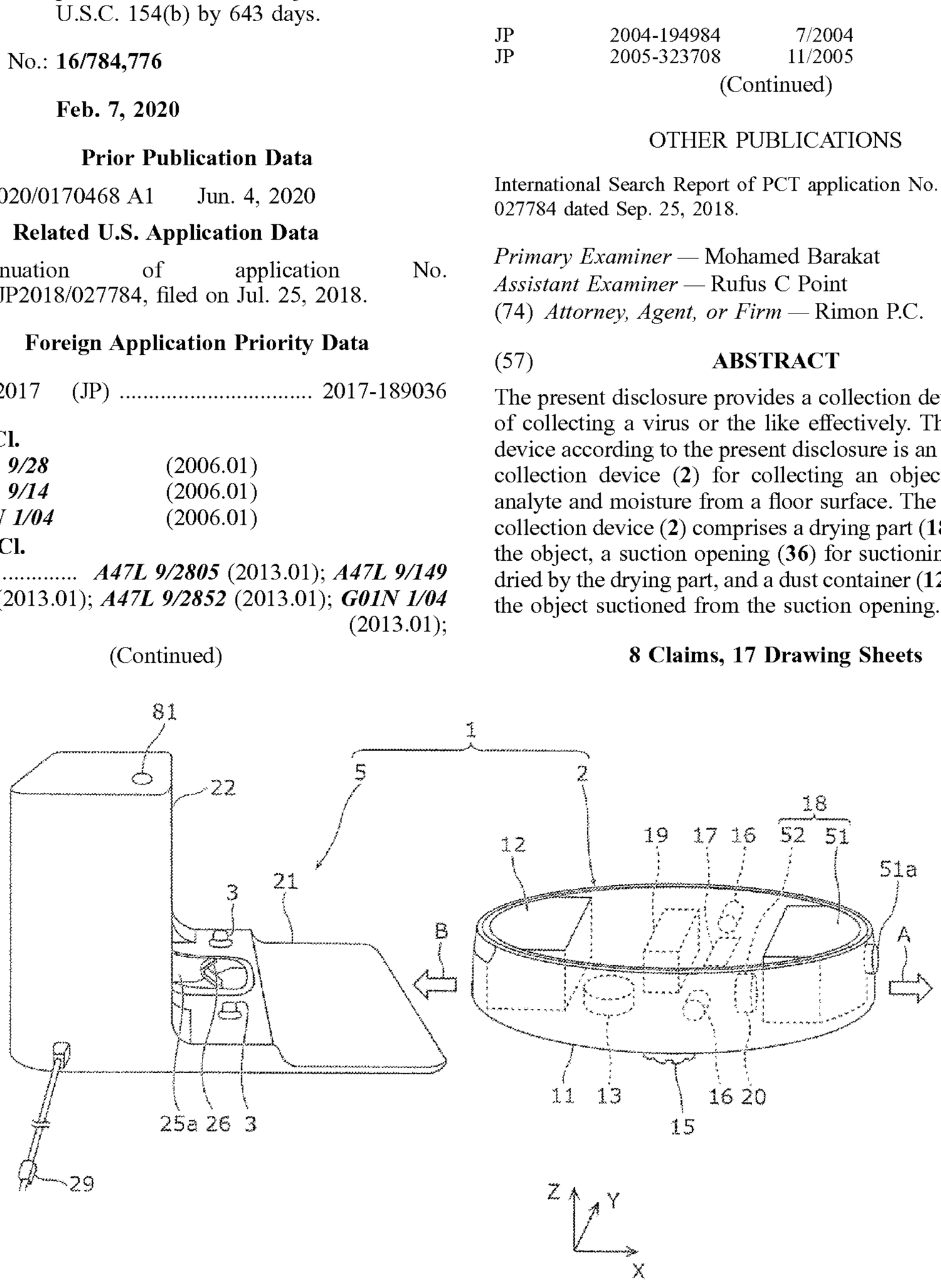
(57) **ABSTRACT**

The present disclosure provides a collection device capable of collecting a virus or the like effectively. The collection device according to the present disclosure is an autonomous collection device (**2**) for collecting an object having an analyte and moisture from a floor surface. The autonomous collection device (**2**) comprises a drying part (**18**) for drying the object, a suction opening (**36**) for suctioning the object dried by the drying part, and a dust container (**12**) for storing the object suctioned from the suction opening.

8 Claims, 17 Drawing Sheets



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CPC *A47L 2201/024* (2013.01); *A47L 2201/04* (2013.01)

(58) **Field of Classification Search**
CPC A47L 9/00; A47L 9/009; A47L 9/0477; A47L 9/2857; A47L 2201/022; A47L 2201/06; A47L 9/106; A47L 11/4013; A47L 11/4036; G01N 1/04; G01N 1/2214; G01N 2001/028; G01N 1/02
See application file for complete search history.

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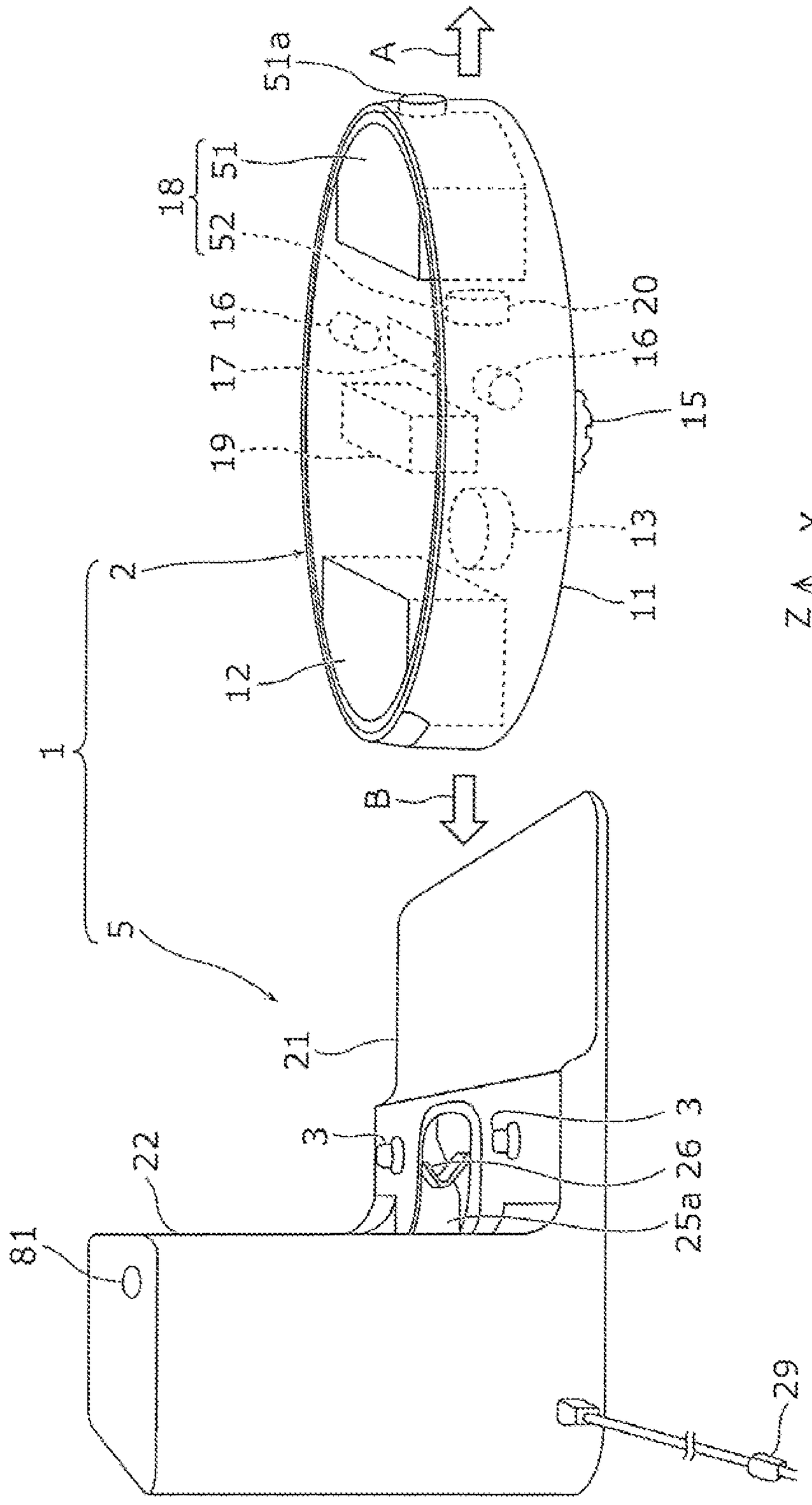
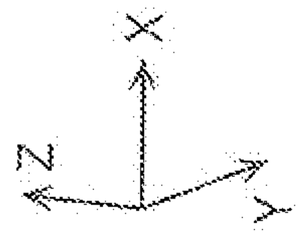


FIG. 1



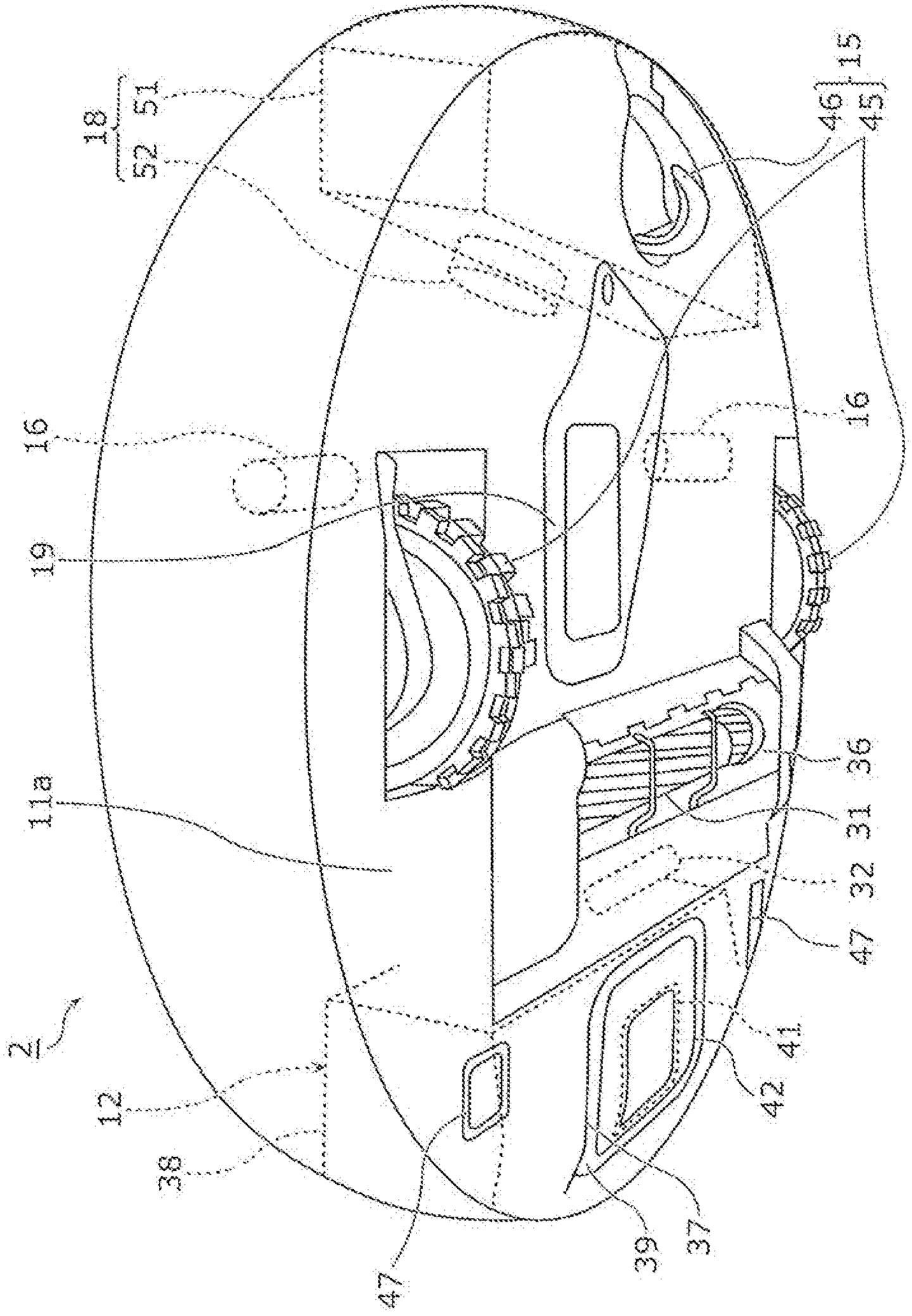


FIG. 2

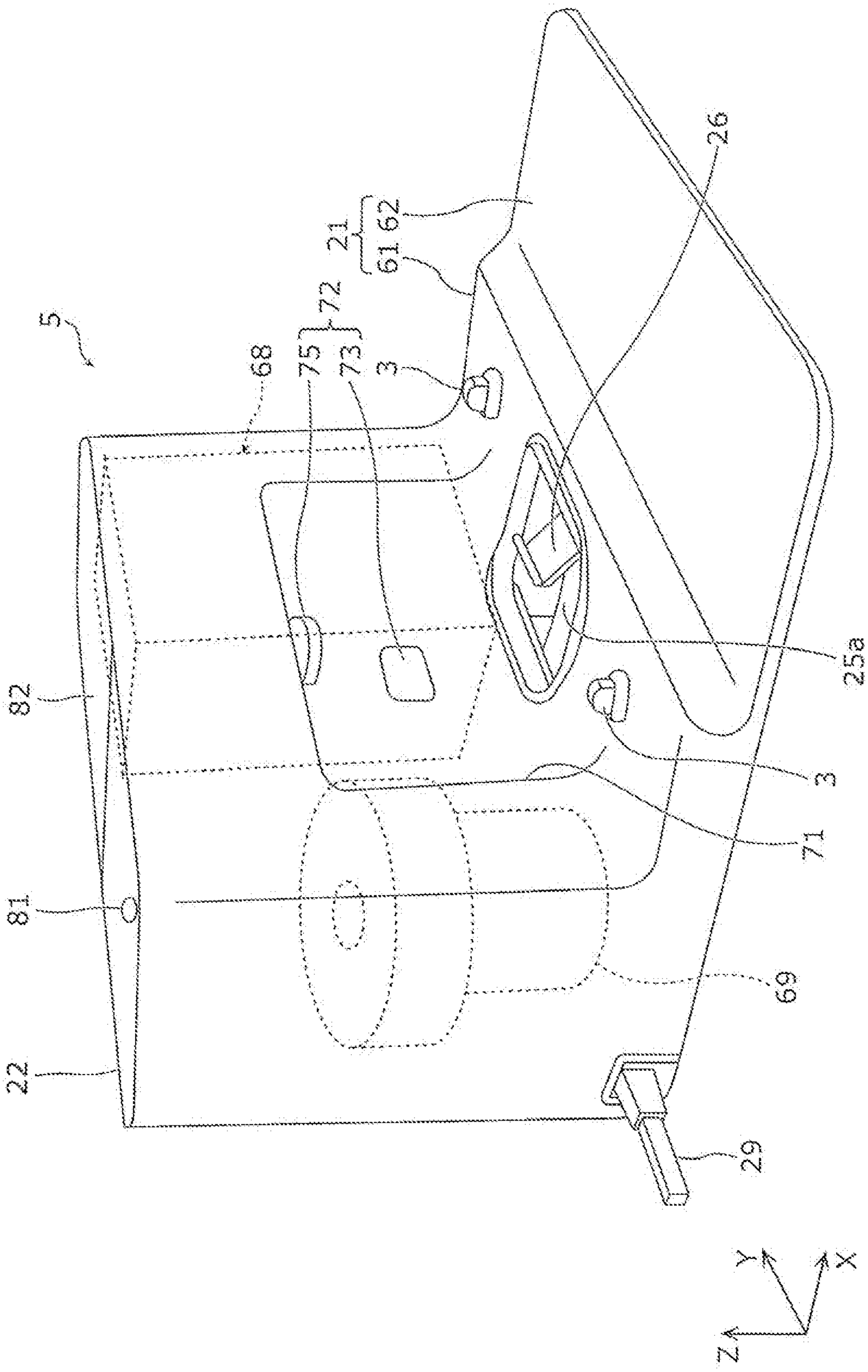


FIG. 3

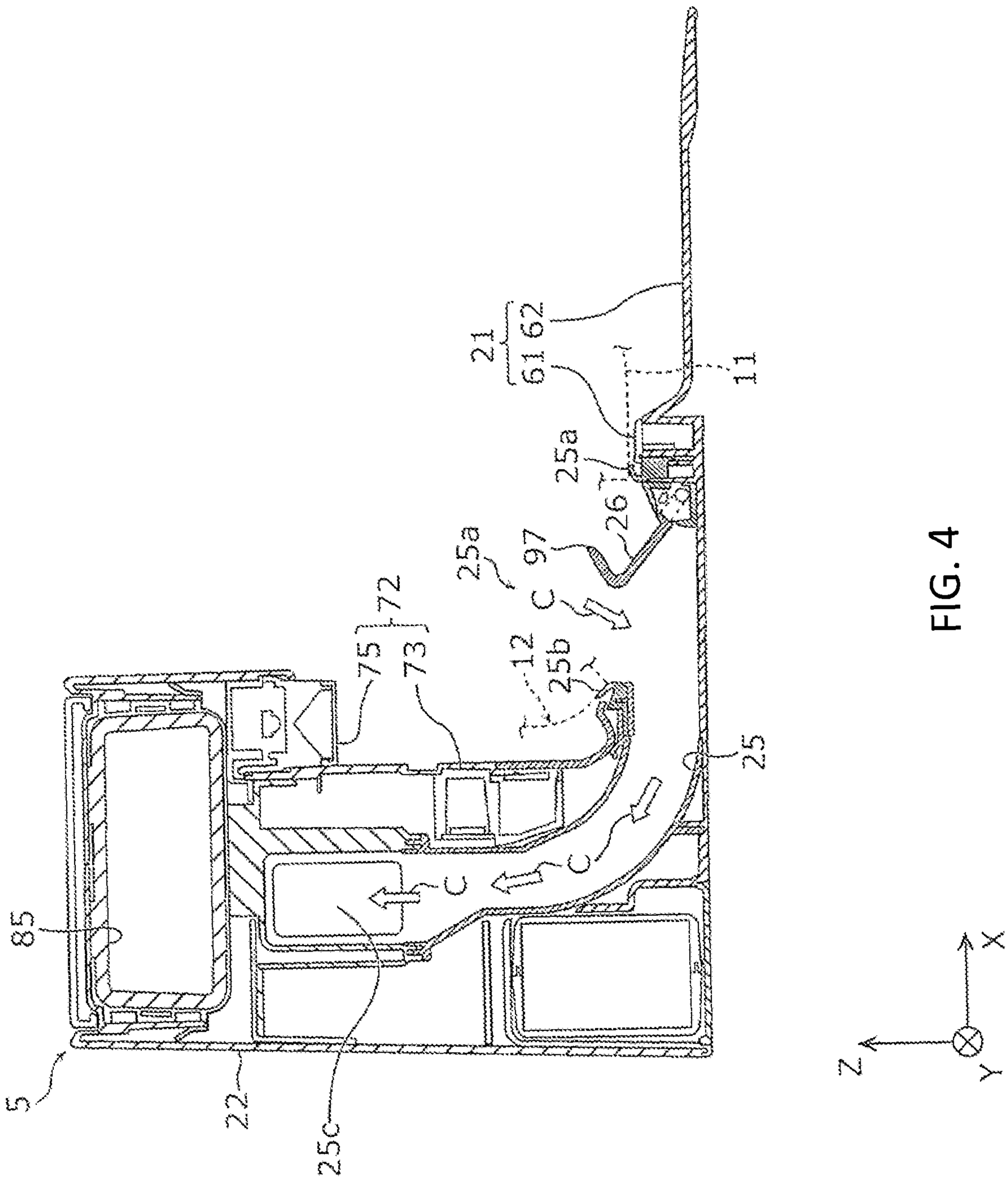


FIG. 4

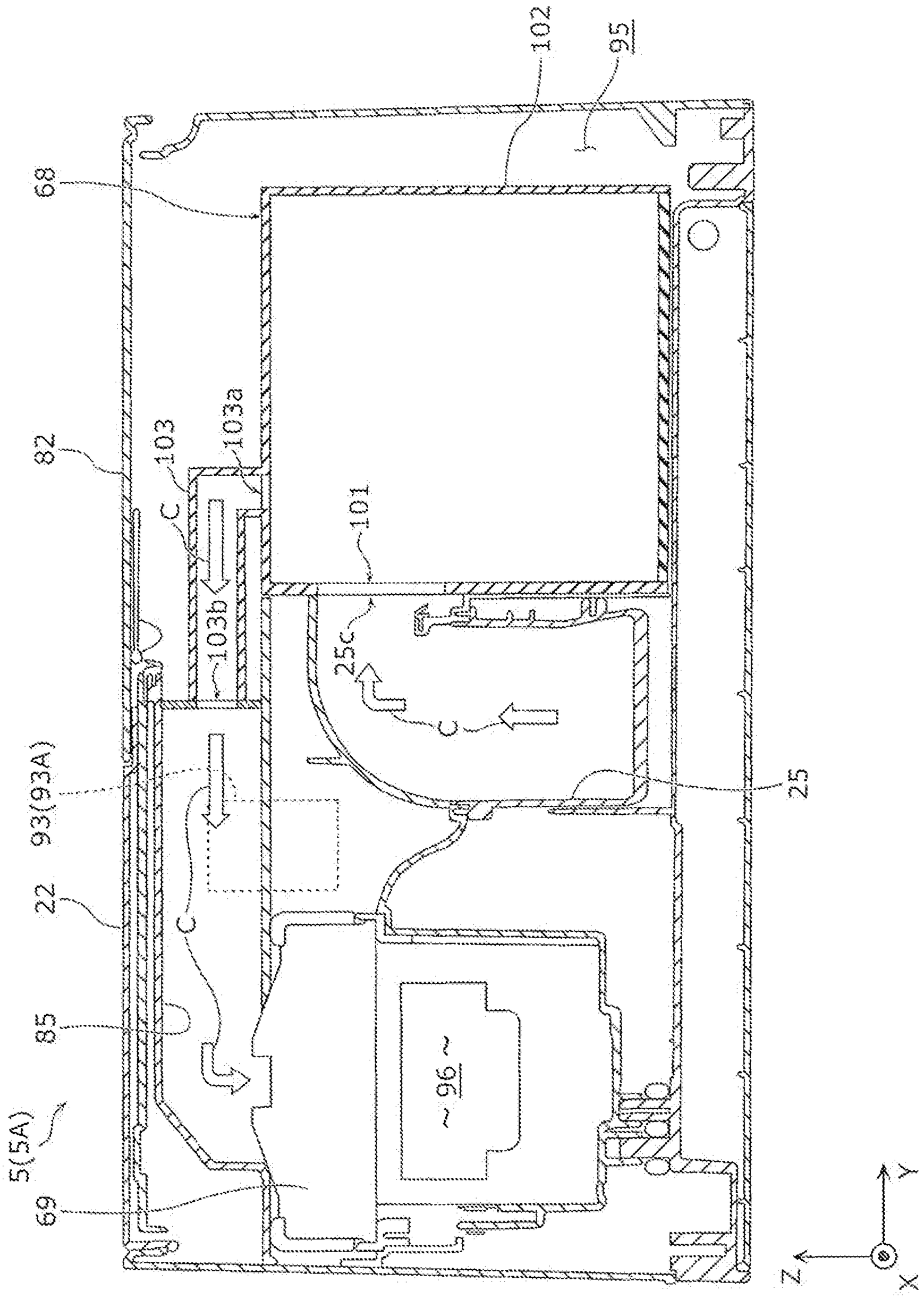


FIG. 5A

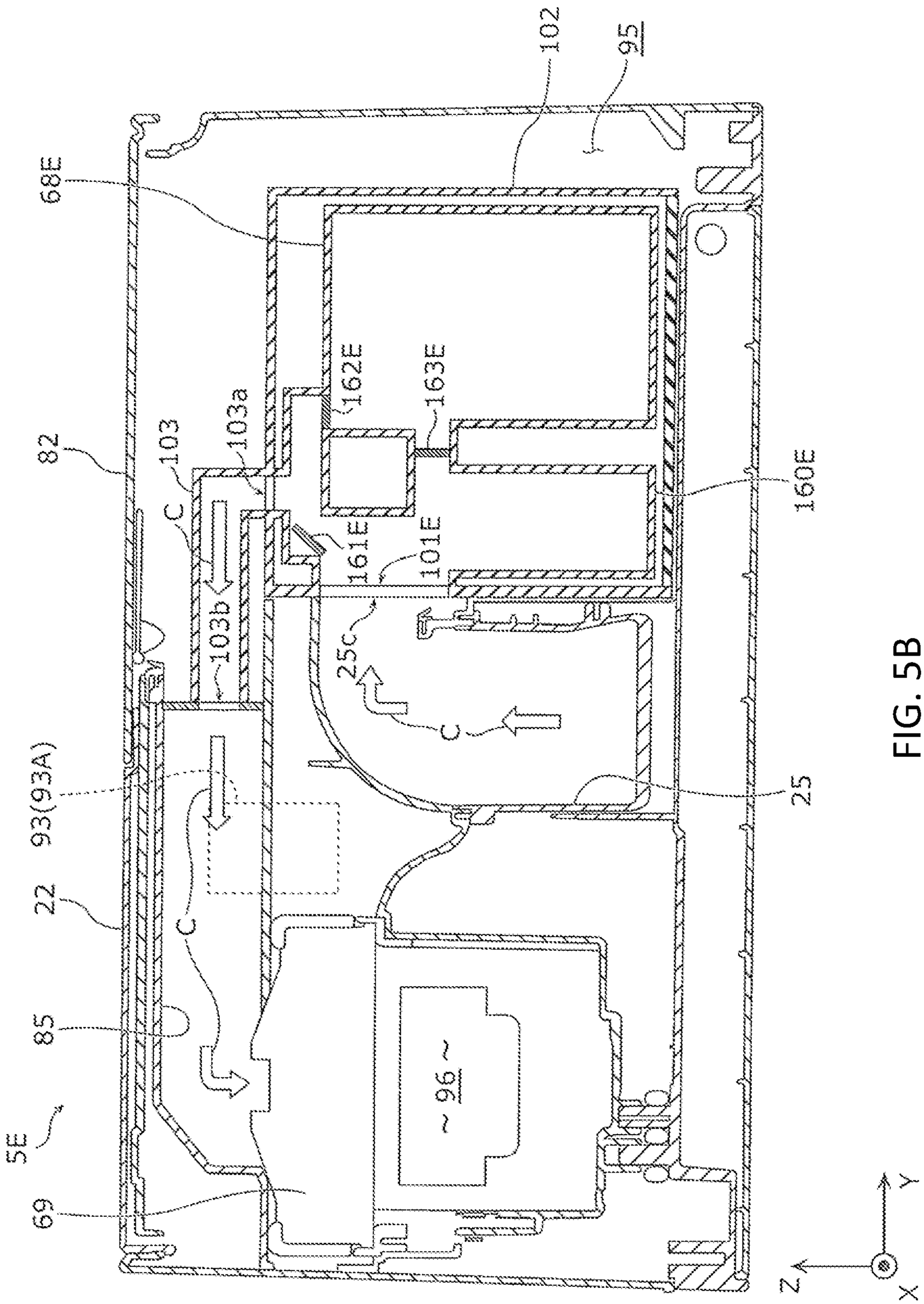

102
95
68E
162E
163E
82
103
103a
160E
161E
101E
103b
25c
C
22
93(93A)
25
85
96
5E
69
Y
Z
X

FIG. 5B

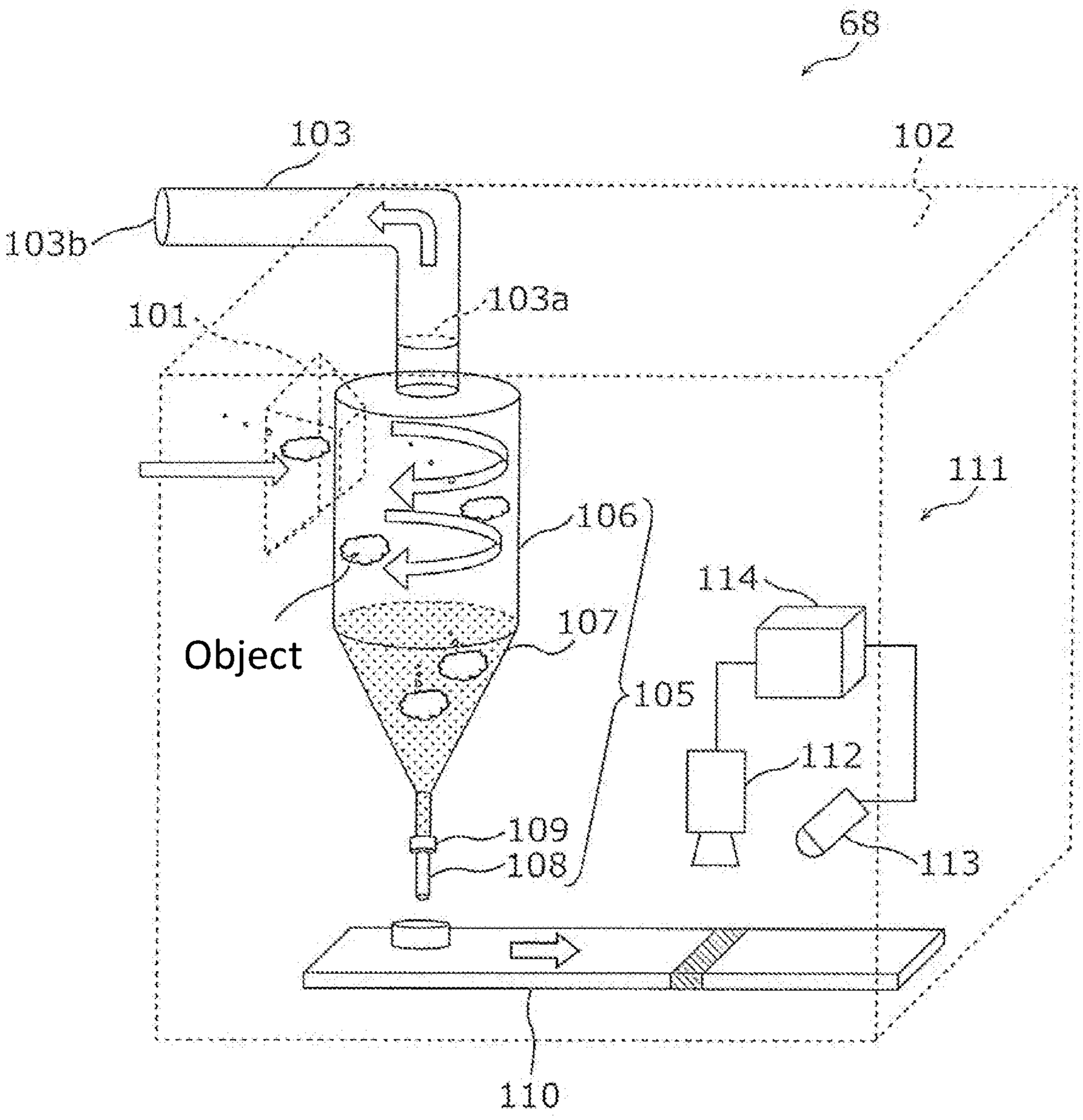

68
103
102
103b
103a
101
111
106
114
107
Object
105
112
109
108
113
110

FIG. 6

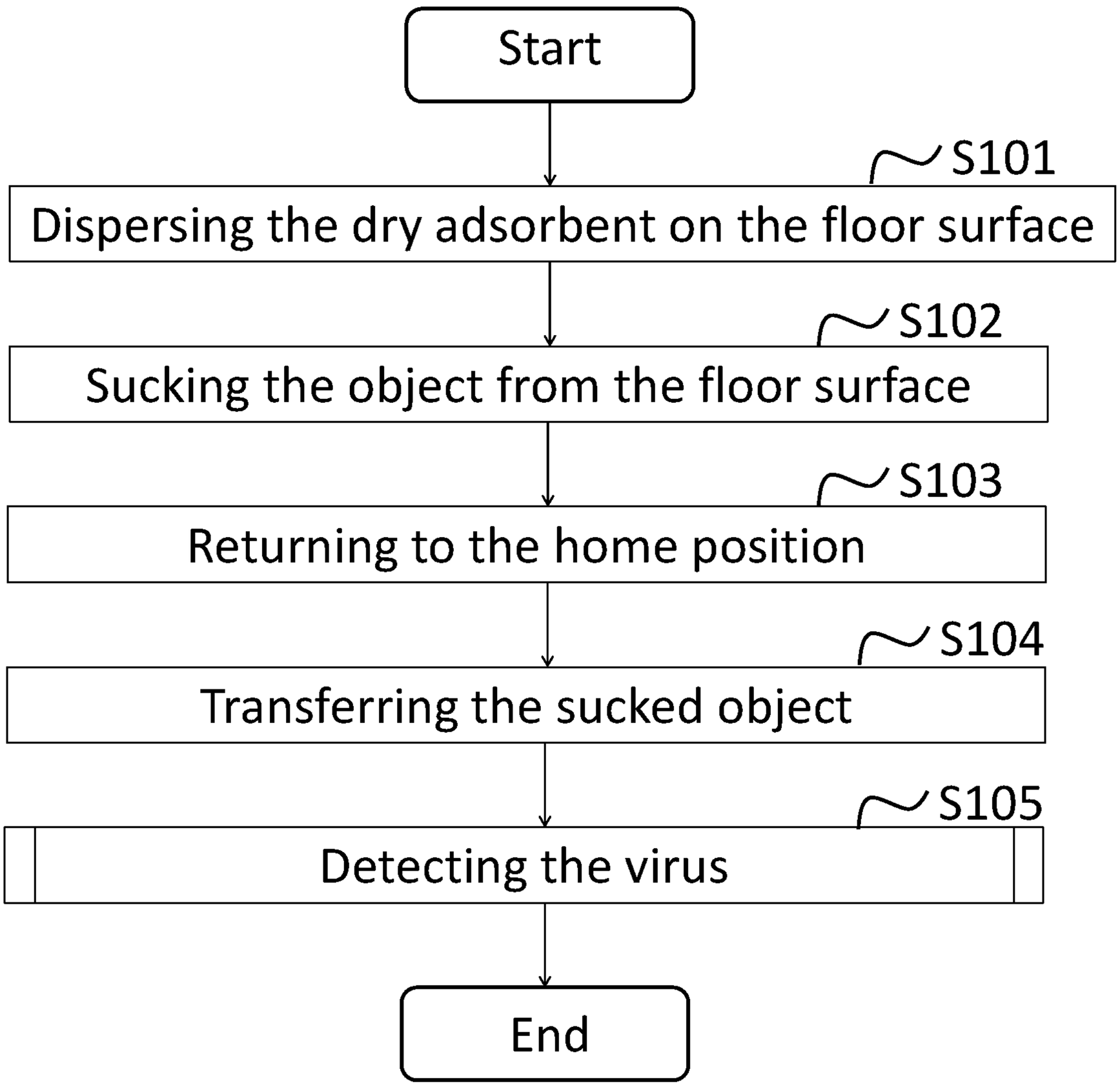

Start
S101
Dispersing the dry adsorbent on the floor surface
S102
Sucking the object from the floor surface
S103
Returning to the home position
S104
Transferring the sucked object
S105
Detecting the virus
End

FIG. 7

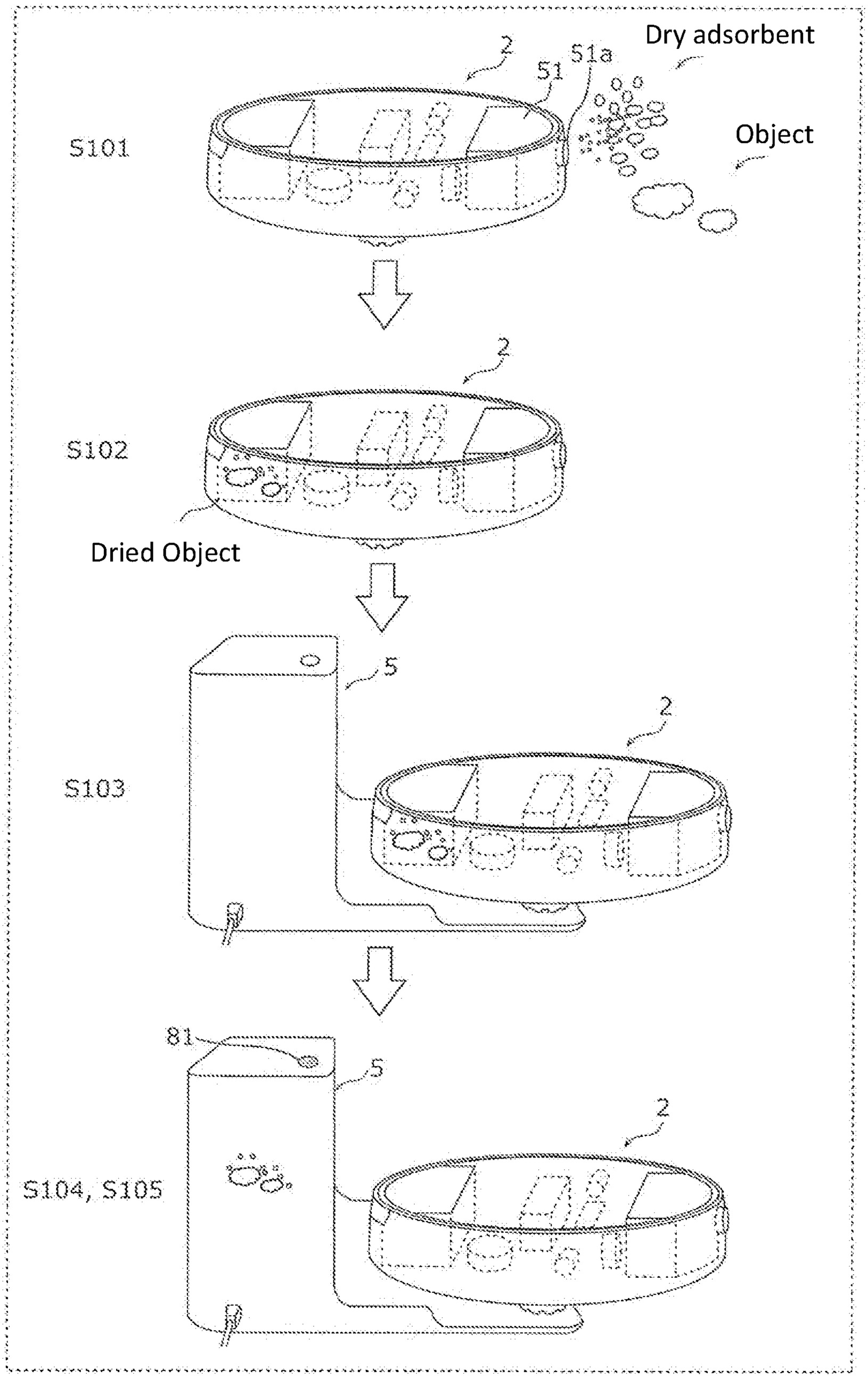

S101
2
51
51a
Dry adsorbent
Object
S102
2
Dried Object
S103
5
2
81
5
2
S104, S105

FIG. 8

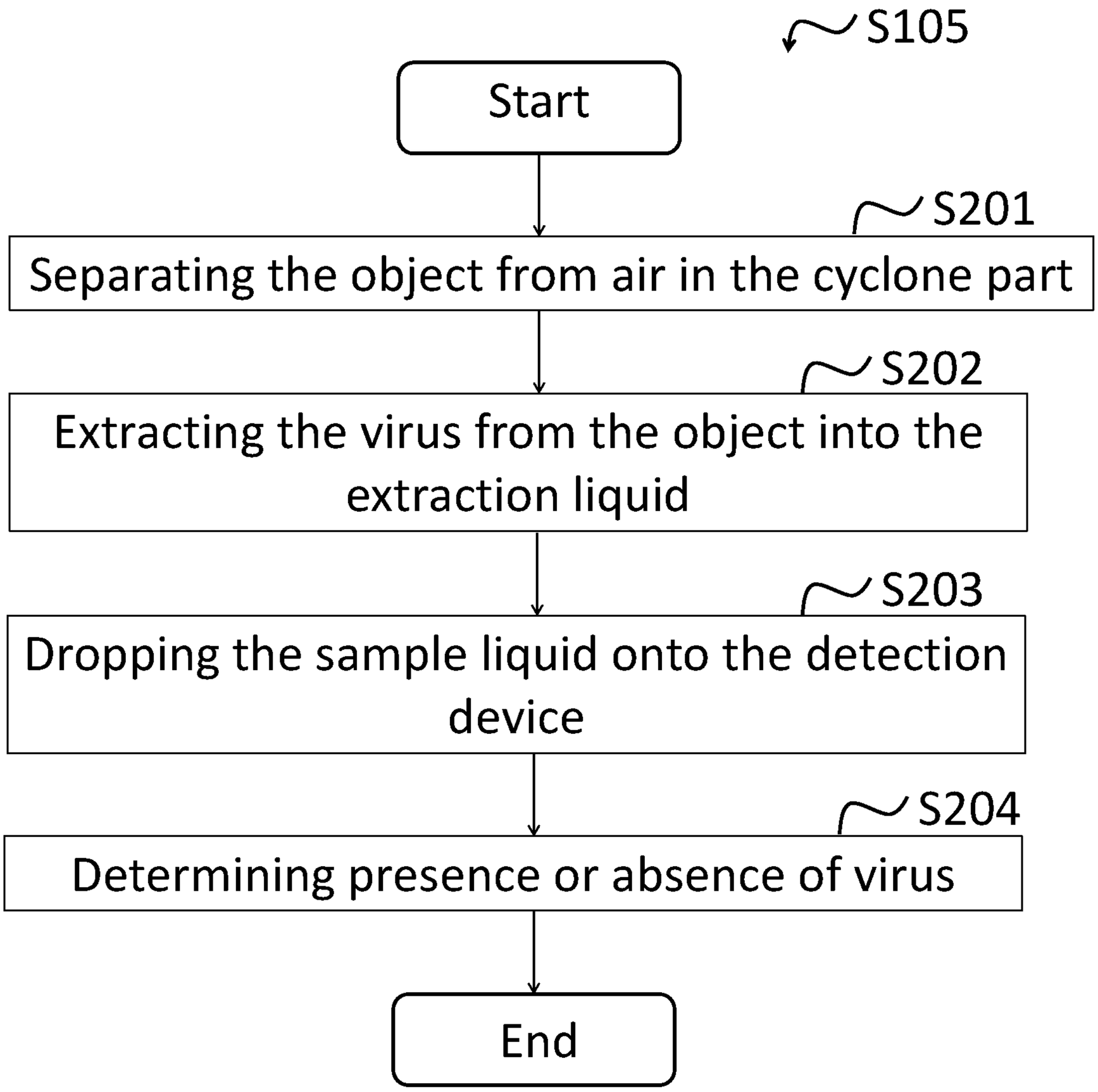

S105
Start
S201
Separating the object from air in the cyclone part
S202
Extracting the virus from the object into the extraction liquid
S203
Dropping the sample liquid onto the detection device
S204
Determining presence or absence of virus
End

FIG. 9

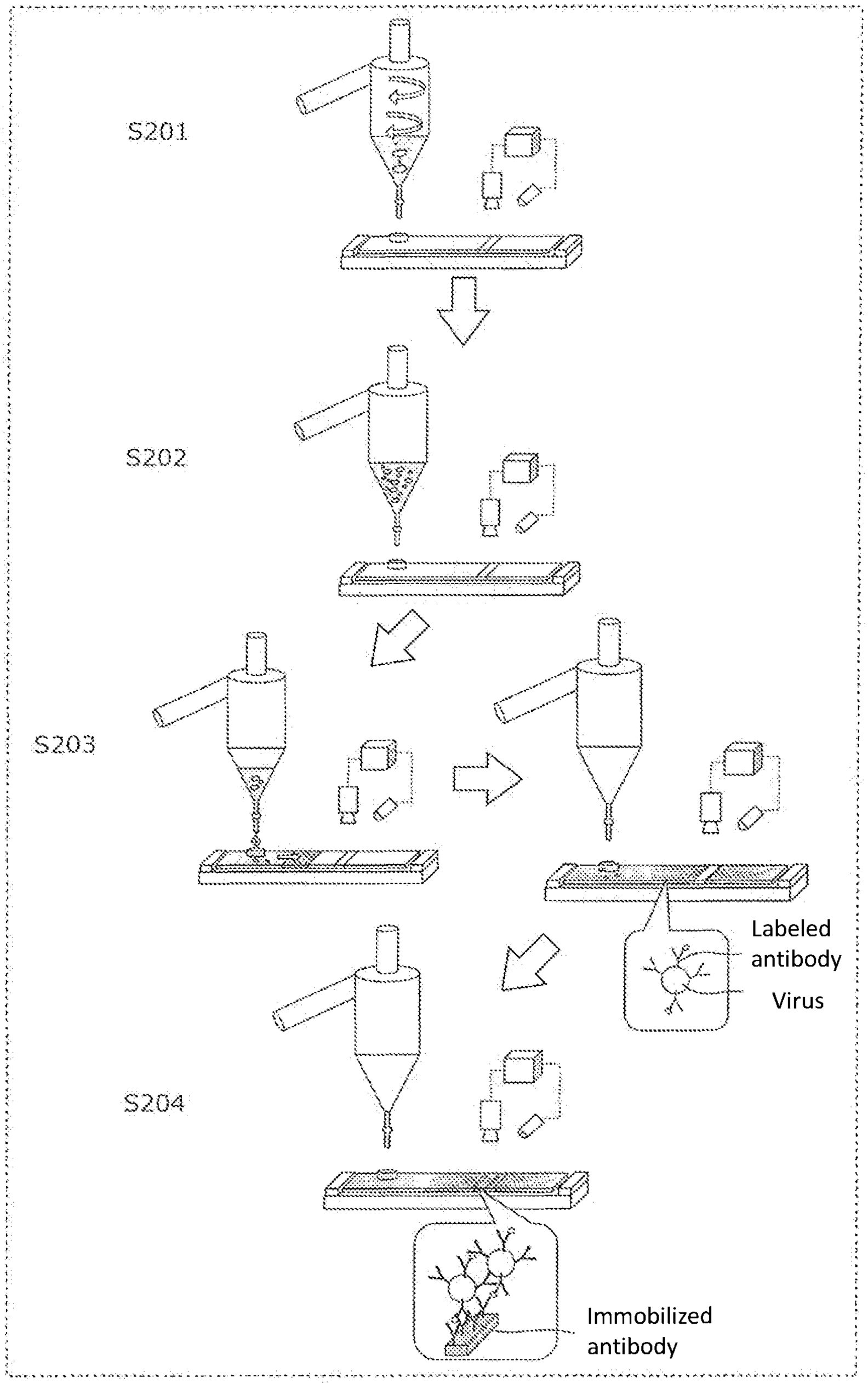

S201
S202
S203
S204
Labeled antibody
Virus
Immobilized antibody

FIG. 10

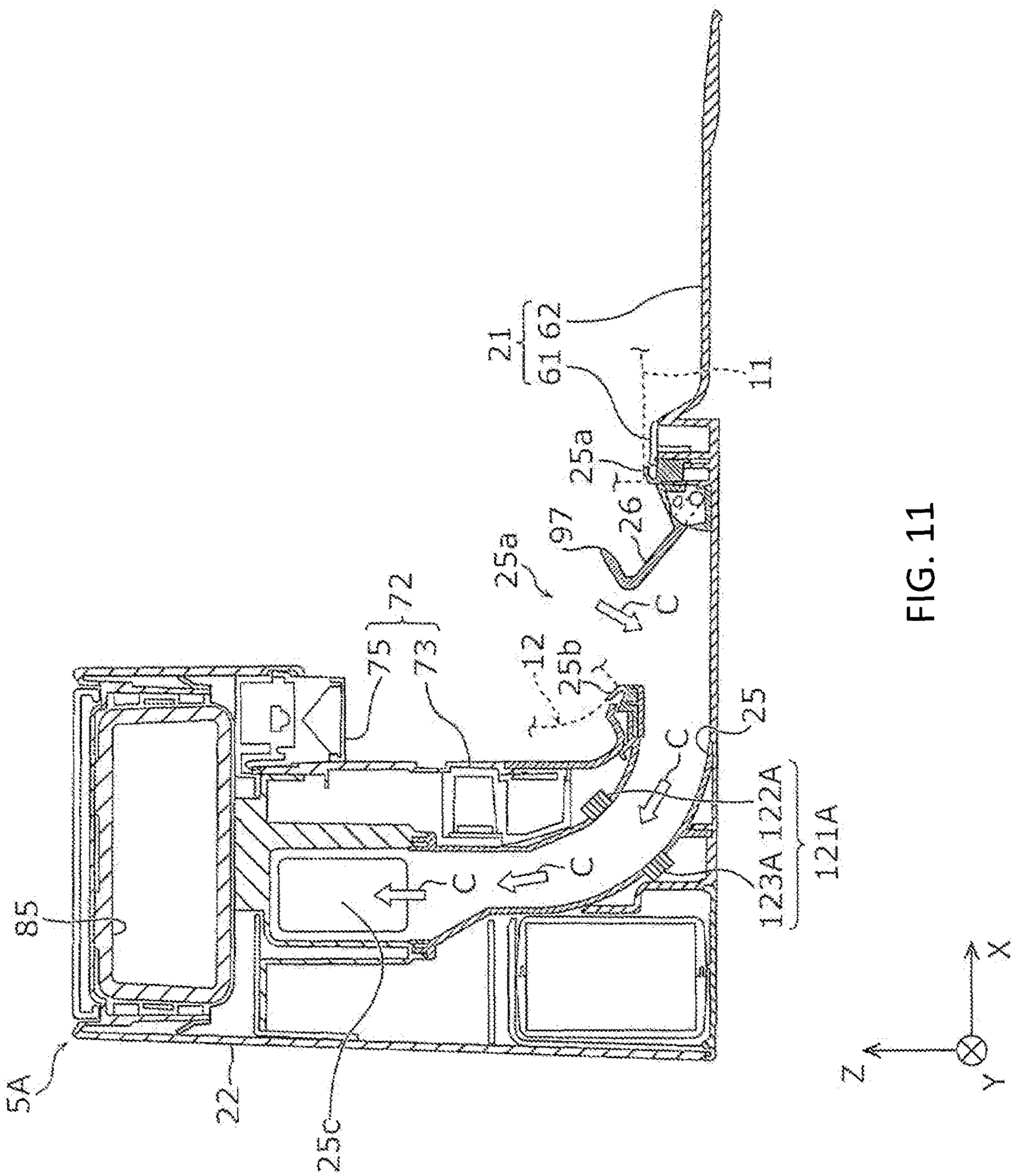

85
5A
22
25c
75
72
73
12
25b
25a
97
26
25a
21
6162
11
25
C
121A
123A 122A

FIG. 11

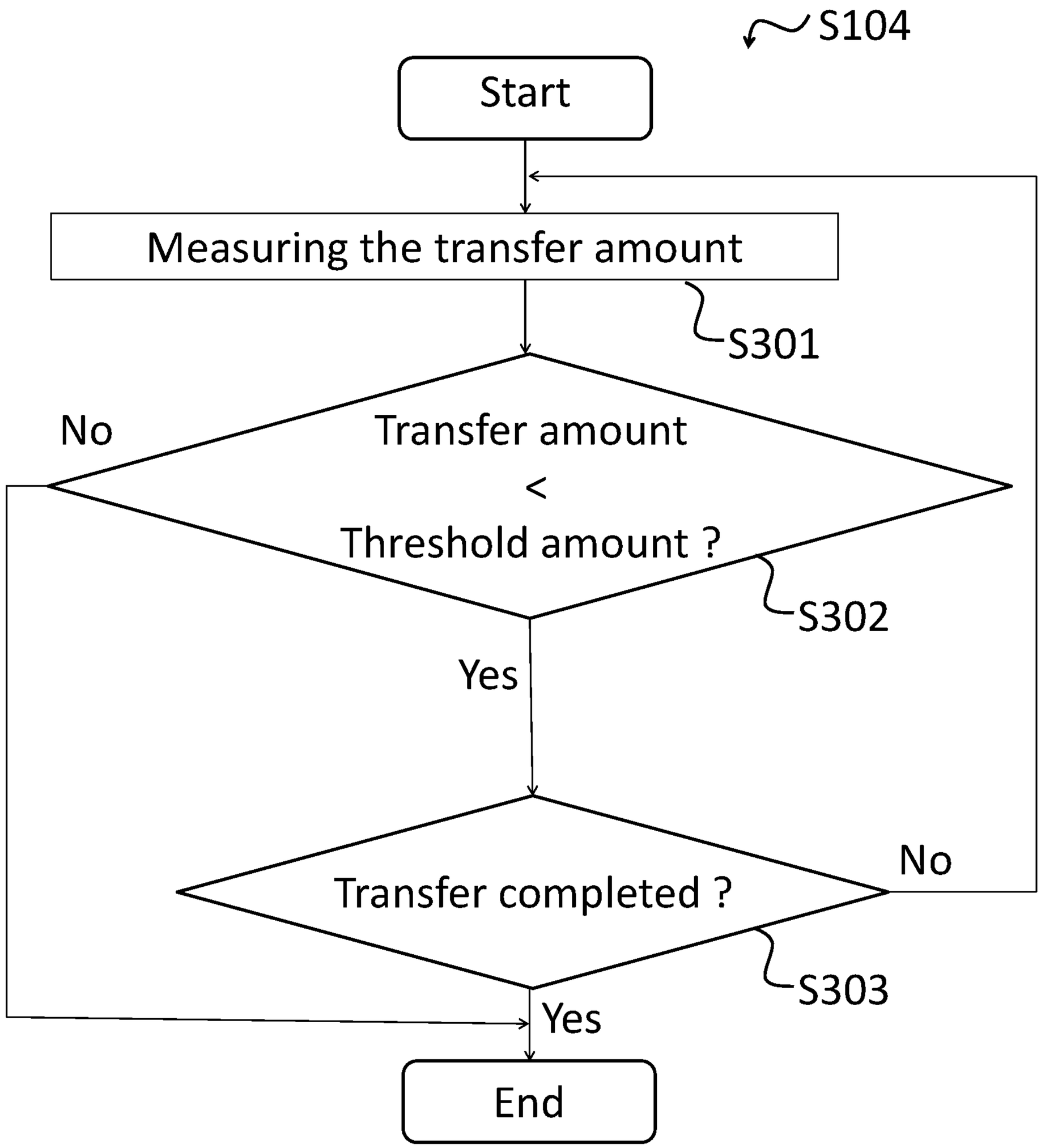

S104
Start
Measuring the transfer amount
S301
Transfer amount
<
Threshold amount ?
No
S302
Yes
Transfer completed ?
No
S303
Yes
End

FIG. 12

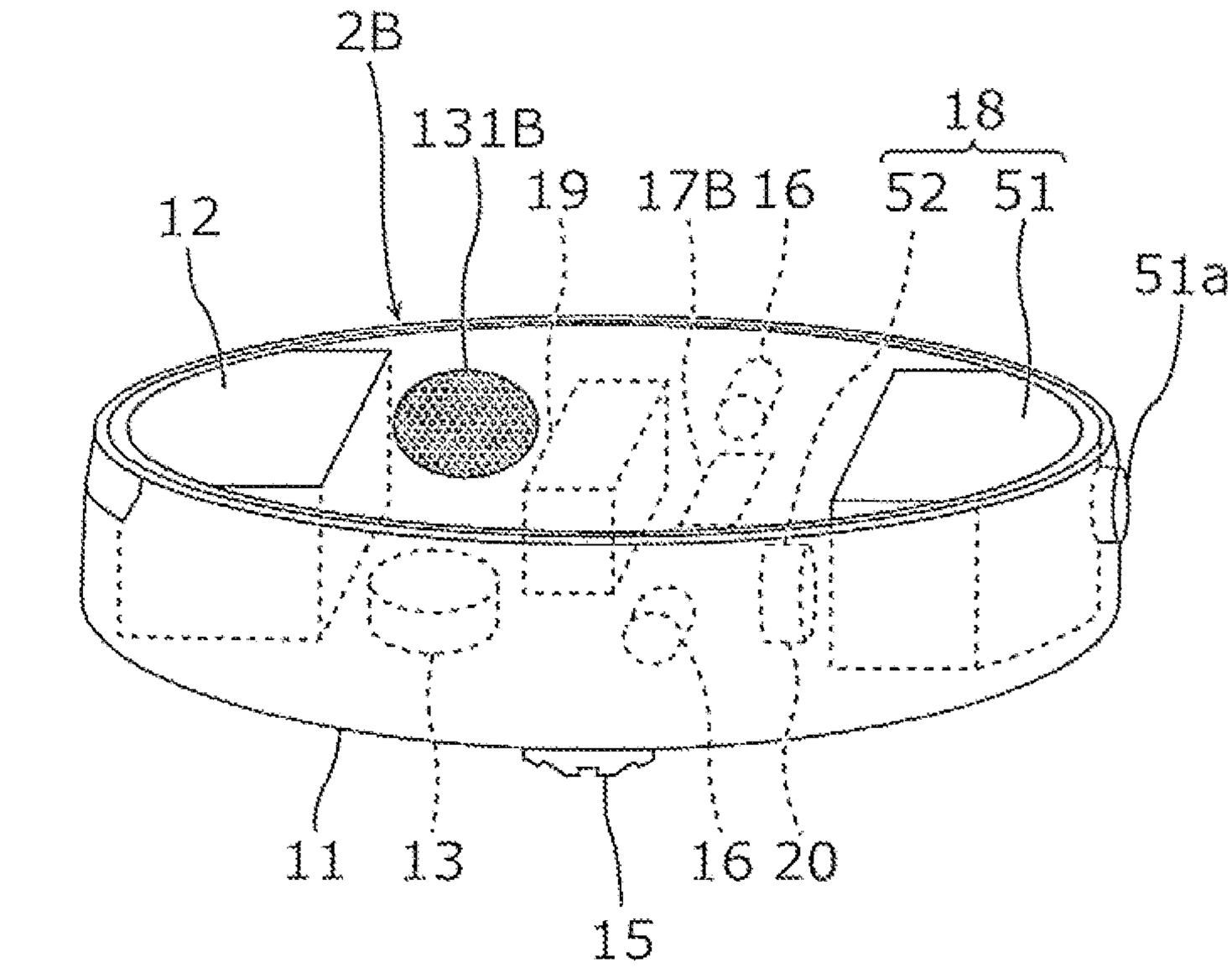


FIG. 13

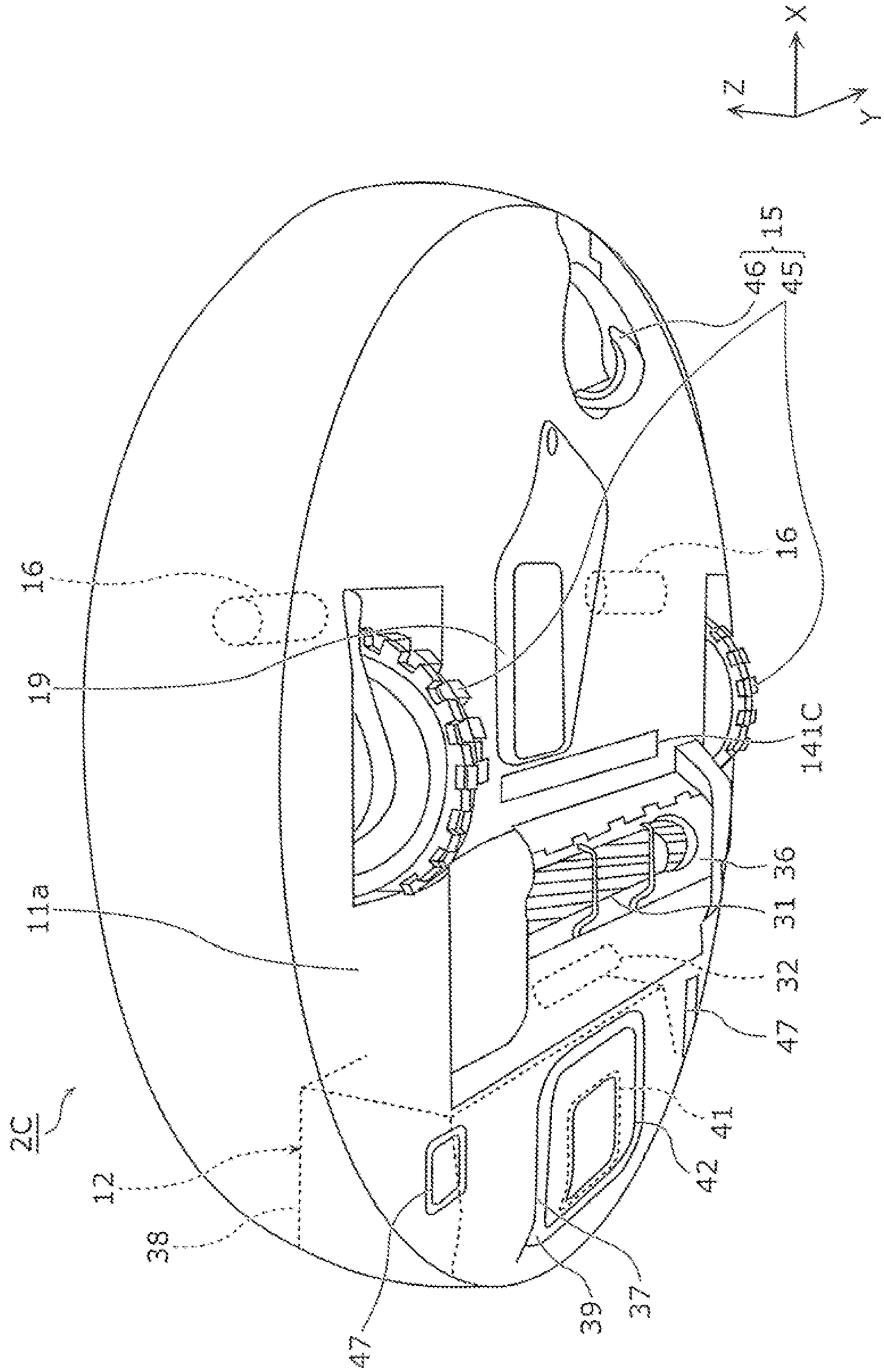


FIG. 14

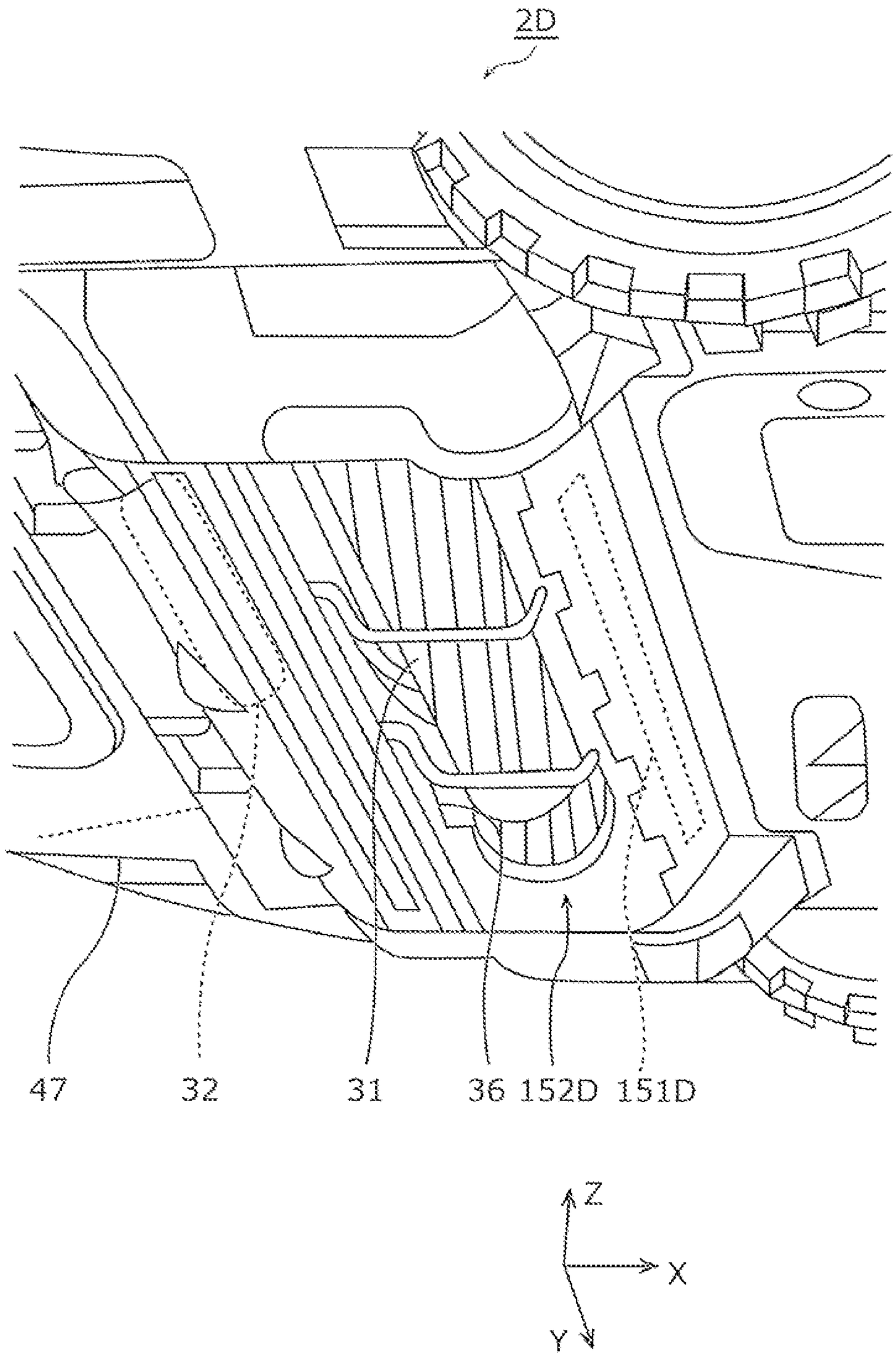
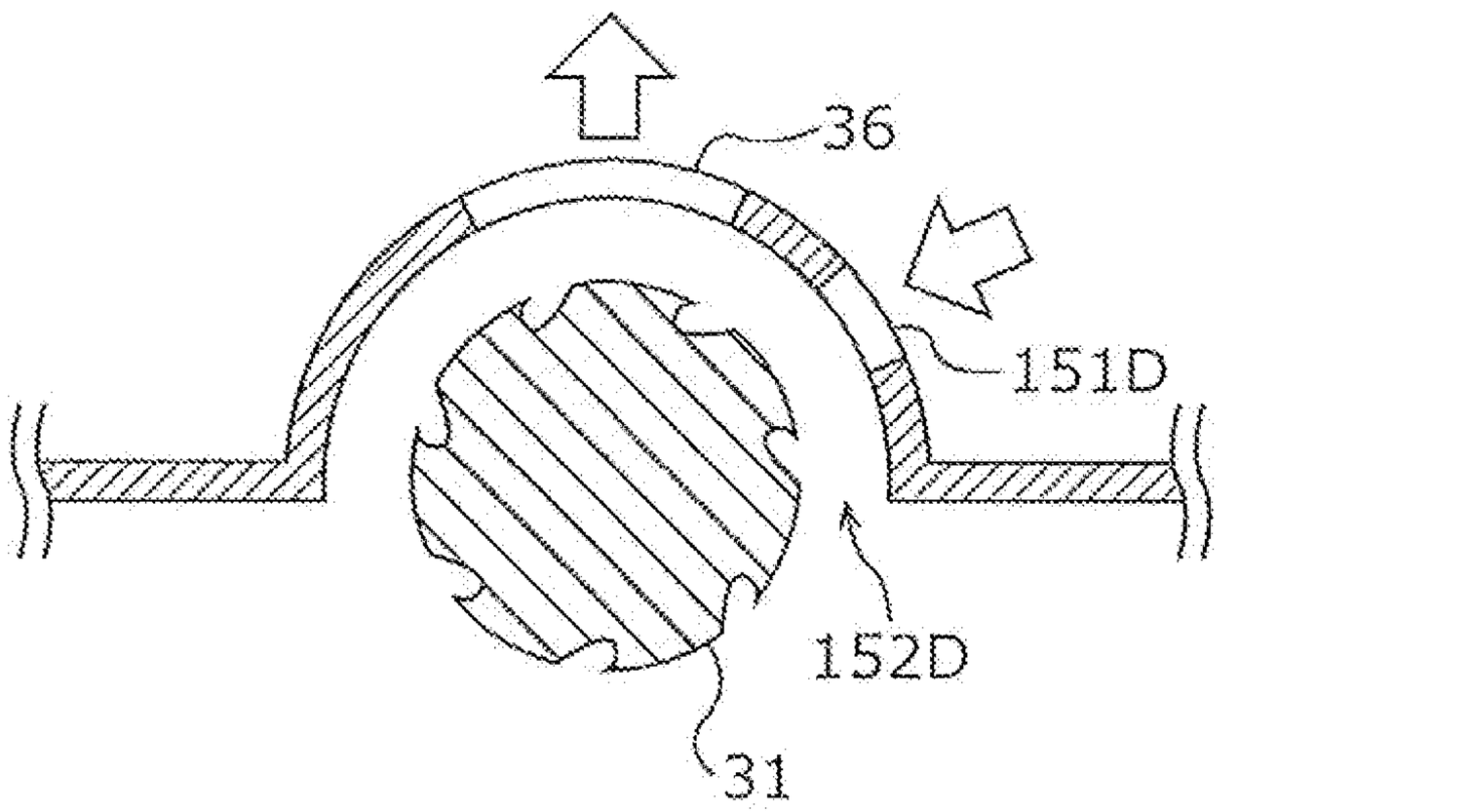


FIG. 15



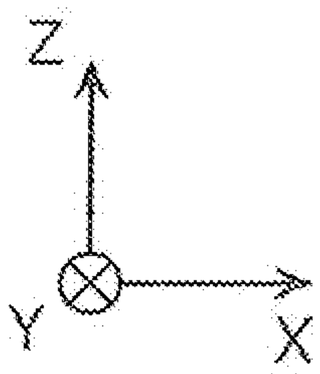


FIG. 16

COLLECTION DEVICE AND DETECTION DEVICE

BACKGROUND

1. Technical Field

The present disclosure relates to a collection device for collecting an object having an analyte such as a virus or a bacterium and water from a floor surface. The present disclosure also relates to a detection device comprising the collection device.

2. Description of the Related Art

Patent Literature 1 discloses a technique for detecting a virus in order to suppress an outbreak (namely, a pandemic) of infection of an influenza virus. In patent Literature 1, the virus floating in the air in a building is collected.

CITATION LIST

Patent Literature

Patent Literature 1: Japanese Patent Application Publication No. 2012-052866A

SUMMARY

The present disclosure provides a collection device capable of collecting a virus effectively. The present disclosure provides a detection device comprising the collection device.

The collection device according to the present disclosure is a collection device for collecting an object having an analyte and moisture from a floor surface, the collection device comprising:

a drying part for drying the object;

a suction part for sucking the object dried by the drying part; and

a storage part for storing the object sucked by the suction part.

The detection device according to the present disclosure comprises the above-mentioned collection device and a detection instrument for connecting fluidically to the collection device when the collection device moves to a predetermined position, for acquiring the object stored in the storage part, and for detecting the analyte from the acquired object.

Note that these comprehensive or specific aspects may be realized by a method, an integrated circuit, a computer program, or a recording medium such as a computer-readable CD-ROM, or realized by an arbitrary combination of the method, the integrated circuit, the computer program, and the recording medium.

The collection device according to the present disclosure can collect a virus effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a schematic diagram of a detection device according to a first embodiment.

FIG. **2** shows a schematic view of a bottom surface of an autonomous collection device according to the first embodiment.

FIG. **3** shows a schematic diagram of a station device according to the first embodiment.

FIG. **4** shows a vertical cross-sectional view of the station device according to the first embodiment.

FIG. **5**A shows a transverse cross-sectional view of the station device according to the first embodiment.

FIG. **5**B shows a transverse cross-sectional view of the station device according to a sixth embodiment.

FIG. **6** shows a schematic diagram of an internal structure of a virus detection part in the first embodiment.

FIG. **7** is a flowchart of operation of the detection device according to the first embodiment.

FIG. **8** shows a process diagram of the operation of the detection device according to the first embodiment.

FIG. **9** is a flowchart of operation of the virus detection part in the first embodiment.

FIG. **10** shows a process diagram of the operation of the virus detection part according to the first embodiment.

FIG. **11** shows a vertical cross-sectional view of a station device according to a second embodiment.

FIG. **12** is a flowchart of a transfer process of an object from an autonomous collection device to the station device according to the second embodiment.

FIG. **13** shows a schematic diagram of an autonomous collection device according to a third embodiment.

FIG. **14** shows a schematic diagram of a bottom surface of an autonomous collection device according to a fourth embodiment.

FIG. **15** shows a partially enlarged diagram of a bottom surface of an autonomous collection device according to a fifth embodiment.

FIG. **16** is a cross-sectional view of a suction opening, a blowing opening, and a vicinity thereof which are included in the autonomous collection device according to the fifth embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENT

Hereinafter, embodiments of the present disclosure will be described with reference to the drawings.

Examples of an analyte that can be detected in the present embodiment are viruses and bacteria.

First Embodiment

[Details of Detection Device]

FIG. **1** shows a schematic diagram of a detection device according to the first embodiment.

As shown in FIG. **1**, the detection device **1** according to the first embodiment comprises an autonomous collection device **2** and a station device **5**.

In the drawing, the X axis indicates the front-rear direction of the autonomous collection device **2**. The Y axis indicates the width direction of the autonomous collection device **2**. The Z axis indicates the height direction of the autonomous collection device **2**. The Y axis is perpendicular to the X axis. The Z axis is also perpendicular to the X axis. The Z axis is also perpendicular to the Y axis. The arrow A indicates the forward direction of the autonomous collection device **2**. The arrow B indicates the backward direction of the autonomous collection device **2**. Dashed lines are used to represent internal structures that are basically invisible to the outside.

The autonomous collection device **2** is one example of a collection device. The autonomous collection device **2** is also referred to as a robot cleaner. The autonomous collection device **2** collects an object on a floor surface, while autonomously moving on the floor surface. After the col-

lection, the autonomous collection device **2** autonomously returns to the station device **5**. In the first embodiment, the autonomous collection device **2** moves forward to leave the station device **5**. The autonomous collection device **2** moves backward to return to the station device **5**.

The object on the floor surface is solid or liquid. An example of the solid object on the floor surface is a virus itself attached to the floor surface, dust adhering to the virus, or a dry adsorbent. The dry adsorbent will be described later. An example of the liquid on the floor surface is saliva containing virus. An example of the floor surface is a floor surface of a waiting room in a hospital, a floor surface of an immigration office at an airport, or a floor surface of a living room in a house.

The station device **5** is one example of a detection instrument. The station device **5** is provided on the floor surface. The station device **5** charges the autonomous collection device **2** through charging electrodes **3**, when the autonomous collection device **2** is located at the home position. The station device **5** further transfers the object collected by the autonomous collection device **2** from the autonomous collection device **2** to the station device **5**. Subsequently, the station device **5** detects a virus from the object transferred from the autonomous collection device **2**.

[Details of Autonomous Collection Device]

Next, the autonomous collection device **2** according to the first embodiment will be described in detail with reference to FIG. **1** and FIG. **2**. FIG. **2** shows a schematic view of a bottom surface of the autonomous collection device according to the first embodiment.

As shown in FIG. **1**, the autonomous collection device **2** comprises a main body case **11**, a dust container **12**, a primary electric blower **13**, a moving part **15**, a drive part **16**, a robot control part **17**, a drying part **18**, and a secondary battery **19**. Furthermore, as shown in FIG. **2**, the autonomous collection device **2** comprises a center brush **31** provided on a bottom surface **11***a* of the main body case **11** and a center brush drive part **32** for driving the center brush **31**. Hereinafter, the autonomous collection device **2** will be described in detail.

[Main Body Case]

The main body case **11** has a hollow disk shape. The body case **11** is formed of, for example, synthetic resin. A horizontally long suction opening **36** extending in the width direction thereof is provided at a center of the rear part of the bottom surface **11***a* of the main body case **11**.

The suction opening **36** has a width of about two thirds of the width (namely, the diameter) of the main body case **11**. The suction opening **36** is fluidically connected to the primary electric blower **13** through the dust container **12**.

The main body case **11** has a dust container opening **37** on the bottom surface **11***a*. The dust container opening **37** is disposed behind the suction opening **36** and in a part covering the lower part of the dust container **12**. The dust container opening **37** is a rounded rectangular opening. The dust container opening **37** partially exposes the dust container **12** attached to the main body case **11**.

[Dust Container]

The dust container **12** is one example of a storage part for storing the object. In the first embodiment, the dust container **12** is detachably provided at the rear part of the main body case **11**. The dust container **12** stores the object sucked from the suction opening **36** by the suction negative pressure generated by the primary electric blower **13**. A filter or a separation device is applied to the dust container **12**. The filter collects the object by filtering the air flowing together with the object. The separation device separates the object from the air by centrifugal separation (i.e. cyclone separation) or inertial separation of straight separation.

The dust container **12** is disposed behind the suction opening **36** and at the rear part of the main body case **11**. The dust container **12** comprises a container main body **38** which is detachably provided on the main body case **11** and can store the object collected by the autonomous collection device **2**, a connection part **39** that is exposed from the dust container opening **37** in a state where attached to the main body case **11**, a disposal opening **41** that is provided in the connection part **39** and through which the object is passed when the object stored in the container main body **38** is disposed of, and a disposal lid **42** for opening and closing the disposal opening **41**.

[Primary Electric Blower]

The primary electric blower **13** is one example of a suction part for sucking the object on the floor surface. The primary electric blower **13** is contained in the main body case **11** and connected to the dust container **12**. The primary electric blower **13** sucks the object on the floor surface from the suction opening **36** through the dust container **12**.

[Moving Part]

The moving part **15** is one example of a moving mechanism for moving on the floor surface. The moving part **15** moves the autonomous collection device **2** on the floor surface. Specifically, the moving part **15** comprises a pair of left and right drive wheels **45** and a turning wheel **46**.

The pair of the drive wheels **45** is disposed on the bottom surface **11***a* of the main body case **11** and protrudes from the bottom surface **11***a*. Accordingly, the pair of the drive wheels **45** are grounded to the floor surface in a state where the autonomous collection device **2** is placed on the floor surface. The pair of the drive wheels **45** are disposed at a substantially central part of the main body case **11** in the front-rear direction of the main body case **11**, and are disposed on the left and right side parts in the width direction of the main body case **11**. Each rotation shaft of the pair of the drive wheels **45** is disposed in parallel to the width direction of the main body case **11**. The autonomous collection device **2** moves forward or backward by rotating the pair of the drive wheels **45** in the same direction. The autonomous collection device **2** turns clockwise or counterclockwise by rotating the pair of the drive wheels **45** in a direction opposite to each other.

The turning wheel **46** is a rotatable carrying wheel. The turning wheel **46** is disposed at a substantially central part in the width direction of the bottom surface **11***a* of the main body case **11** and at the front part of the main body case **11**.

[Drive Part]

The drive part **16** drives the moving part **15**. Specifically, the drive part **16** is a pair of electric motors connected to the pair of the drive wheels **45**. The drive part **16** drives the pair of the drive wheels **45** independently.

[Robot Control Part]

The robot control part **17** is contained in the main body case **11**. The robot control part **17** controls the drive part **16** to autonomously move the autonomous collection device **2** on the floor surface.

Specifically, the robot control part **17** comprises a microprocessor (not shown) and a storage device (not shown) that stores various calculation programs and parameters executed by the microprocessor. The robot control part **17** is electrically connected to the primary electric blower **13**, the center brush drive part **32**, the drive part **16**, and the drying part **18**.

[Drying Part]

The drying part **18** dries the object that has the virus and moisture and is on the floor surface. In other words, the drying part **18** decreases the amount of water contained in the object. In the first embodiment, the drying part **18** comprises a dry adsorbent container **51** and a dry adsorbent dispersion means **52**.

The object is dust to which the saliva containing a virus has adhered. Further, for example, the object may be saliva itself. Further, for example, the object may be a dry adsorbent in which saliva has been absorbed.

The dry adsorbent container **51** is one example of a storing part for storing the dry adsorbent. The dry adsorbent container **51** is detachably provided at the front part of the main body case **11**. An opening **51***a* is provided on the front surface of the dry adsorbent container **51**. The dry adsorbent is dispersed from the opening **51***a*.

The dry adsorbent has a property of absorbing liquid. The dry adsorbent may have a property of adsorbing the analyte. An example of the dry adsorbent is a superabsorbent polymer.

The dry adsorbent dispersion means **52** is one example of a dispersion part for dispersing the dry adsorbent on the floor surface. The dry adsorbent dispersion means **52** is fluidically connected to the dry adsorbent container **51**. The dry adsorbent dispersion means **52** disperses the dry adsorbent from the opening **51***a* of the dry adsorbent container **51** onto the floor surface in front of the autonomous collection device **2** by sending air into the dry adsorbent container **51**. An example of the dry adsorbent dispersion means **52** is a blower.

[Secondary Battery]

The secondary battery **19** is a power source of the autonomous collection device **2**. The secondary battery **19** is contained in the main body case **11**. The secondary battery **19** is a power source for the primary electric blower **13**, the center brush drive part **32**, the drive part **16**, the robot control part **17**, and the drying part **18**. For example, the secondary battery **19** is disposed between the turning wheel **46** and the suction opening **36**. The secondary battery **19** is electrically connected to a pair of charging terminals **47** arranged on the bottom surface **11***a* of the main body case **11**. The secondary battery **19** is charged when the charging terminals **47** are electrically connected to the charging electrodes **3** of the station device **5**.

The center brush **31** is provided in the vicinity of the suction opening **36**. The center brush **31** is an axial brush capable of rotating around a rotation center line extending in the width direction of the main body case **11**. The center brush **31** comprises, for example, a long shaft part (not shown) and a plurality of brushes (not shown) that extend in the radial direction of the shaft part and are helically arranged along the longitudinal direction of the shaft part. The center brush **31** is provided in a recess part having the suction opening **36**. The center brush **31** protrudes downward from the bottom surface **11***a* of the main body case **11**. In a state where the autonomous collection device **2** is placed on the floor surface, at least one of the plurality of the brushes included in the center brush **31** is contact with the floor surface.

The center brush drive part **32** is contained in the main body case **11**. In the first embodiment, the center brush drive part **32** is an electric motor capable of rotating the center brush **31**.

[Details of Station Device]

Next, the station device **5** according to the first embodiment will be described in detail with reference to FIG. **1** and FIG. **3**. FIG. **3** shows a schematic diagram of the station device according to the first embodiment.

As shown in FIG. **1** and FIG. **3**, the station device **5** comprises a pedestal **21**, a housing **22**, and a power cord **29** through which power from a commercial AC power supply passes.

The pedestal **21** is disposed on the front side of the station device **5**, protrudes from the housing **22**, and extends in a rectangular shape. The pedestal **21** comprises a high floor surface part **61** projecting from the bottom of the housing **22** and a low floor surface part **62** projecting from the high floor surface part **61**. The low floor surface part **62** and the high floor surface part **61** extend in a strip shape along the width direction of the station device **5**. The pair of the charging electrodes **3**, an inlet **25***a* of a transfer pipe **25**, and a lever **26** are disposed on the high floor surface part **61**.

The pair of the charging electrodes **3** are arranged so as to sandwich the inlet **25***a* of the transfer pipe **25** therebetween. The pair of the charging electrodes **3** are disposed in front of the left and right edges of a recess part **71**. The autonomous collection device **2** reaches the home position in such a way that the pair of the drive wheels **45** ride on the low floor surface part **62** and that the dust container **12** is positioned above the high floor surface part **61**.

The home position means a position where the autonomous collection device **2** is electrically connected to the charging electrodes **3** of the station device **5**. The autonomous collection device **2** autonomously returns to this home position in at least one case where charging is necessary and cleaning of the floor surface is completed.

The housing **22** is positioned at the rear side part of the station device **5**, extends upwards beyond the pedestal **21**, and has a rounded rectangular shape. The front wall of the housing **22** comprises the recess part **71** which has a shape of an arc and corresponds to the rear end part of the autonomous collection device **2**. The inlet **25***a* of the transfer pipe **25** extends from the high floor surface part **61** of the pedestal **21** to the recess part **71**.

The recess part **71** is provided with a detection part **72** for detecting whether or not the autonomous collection device **2** has reached the home position. The detection part **72** is an objective sensor for detecting a relative distance from the autonomous collection device **2** using visible light or infrared light. The detection part **72** comprise a first sensor part **73** for detecting a relative distance from the autonomous collection device **2** in the front direction of the housing **22** and a second sensor part **75** for detecting a relative distance from the autonomous collection device **2** in the height direction of the housing **22**. In FIG. **1** and FIG. **3**, the front direction of the housing **22** is the X direction. The height direction of the housing **22** is the Z direction.

The housing **22** comprises a lid **82** for covering a virus detection part **68** contained in the housing **22**. The lid **82** opens and closes a part of the ceiling of the housing **22**, specifically, the right half thereof. The virus detection part **68** is disposed below the lid **82**.

Further, a lamp **81** is provided on the top surface of the housing **22**. The lamp **81** is one example of a presentation part for presenting a detection result provided by the virus detection part **68**. The lamp **81** is lit in a manner corresponding to the detection result. For example, the lamp **81** turns on when a virus is detected, and turns off when no virus is detected. Alternatively, the lamp **81** emits red light when a virus is detected, and emits green light when no virus is detected. In place of these, the lamp **81** blinks when a virus is detected and does not blink when a virus is not detected. In place of the lamp **81**, for example, the station device **5**

may display the detection result using a display. Alternatively, the station device **5** may output a sound which notify provision of a detection result using a speaker. Specifically, the station device **5** may output a warning sound when a virus is detected. The station device **5** does not have to present the detection result. The station device **5** may transmit data of the detection result to another device.

[Inside of Housing]

Here, the inside of the housing **22** will be described in detail with reference to FIG. **4** and FIG. **5**A. FIG. **4** shows a vertical cross-sectional view of the station device according to the first embodiment. FIG. **5**A shows a transverse cross-sectional view of the station device according to the first embodiment. In FIG. **5**A, the inside of the virus detection part **68** is omitted.

As shown in FIG. **4** and FIG. **5**A, the housing **22** contains the transfer pipe **25**, the virus detection part **68**, a secondary electric blower **69**, a downstream pipe **85**, and a control part **93**. The lid **82** is attached to the housing **22**. As shown in FIG. **5**A, the housing **22** has a detection part chamber **95** that contains the virus detection part **68** on the right side thereof. The housing **22** has a blower chamber **96** that contains the secondary electric blower **69** on the left side thereof.

The virus detection part **68** is one example of a substance detection part for detecting the analyte from the object transferred from the dust container **12** of the autonomous collection device **2** through the transfer pipe **25**. Details of the virus detection part **68** will be described later with reference to FIG. **6**.

The secondary electric blower **69** sucks the object from the dust container **12** of the autonomous collection device **2** through the transfer pipe **25**. Specifically, the secondary electric blower **69** is contained in the housing **22** in such a way that a suction port of the secondary electric blower **69** faces the lid **82**. The secondary electric blower **69** generates the suction negative pressure in the transfer pipe **25** through the virus detection part **68**.

As shown in FIG. **4**, the transfer pipe **25** extends rearward from the inlet **25***a* disposed in the high floor surface part **61** of the pedestal **21** and reaches the inside of the housing **22**. The transfer pipe **25** is bent in the housing **22**. The transfer pipe **25** extends upward between the detection part chamber **95** and the blower chamber **96** and reaches the side of the virus detection part **68**. The transfer pipe **25** has the inlet **25***a* that opens toward a part located above the station device **5** and an outlet **25***c* that opens sideways toward the virus detection part **68**.

An annular seal member **25***b* is provided at the inlet **25***a* of the transfer pipe **25**. The annular seal member **25***b* is brought into contact with the connection part **39** of the dust container **12** and is airtightly connected to the disposal opening **41**, when the autonomous collection device **2** is located at the home position. The seal member **25***b* is in close contact with the connection part **39** in a state where the autonomous collection device **2** is located at the home position.

The lever **26** disposed at the inlet **25***a* of the transfer pipe **25** comprises a hook **97** extending in the front direction of the housing **22** and upward. The lever **26** mechanically opens and closes the disposal lid **42** of the autonomous collection device **2** using the hook **97**.

The virus detection part **68** comprises a detection part housing **102**. A discharge pipe **103** is connected to the opening on the top surface of the detection part housing **102**. A suction port **101** is provided on the side surface of the detection part housing **102**. The inside of the virus detection part **68** will be described later with reference to FIG. **6**.

An inlet **103***a* of the discharge pipe **103** is connected to an opening on the top surface of the detection part housing **102**. An outlet **103***b* of the discharge pipe **103** is connected to the inlet of the downstream pipe **85**.

The downstream pipe **85** is an air passage on the suction side of the secondary electric blower **69**. The downstream pipe **85** is disposed above the transfer pipe **25** and extends in the width direction in the housing **22**. The inlet of the downstream pipe **85** is connected to the outlet **103***b* of the discharge pipe **103** of the virus detection part **68**. The outlet of the downstream pipe **85** is connected to the suction port of the secondary electric blower **69**.

The lid **82** is swingably provided on the top surface of the housing **22**. The lid **82** opens and closes the opening on the top surface of the detection part chamber **95** that contains the virus detection part **68**.

When the autonomous collection device **2** returns to the home position of the station device **5**, the charging terminals **47** of the autonomous collection device **2** are electrically connected to the charging electrodes **3** of the station device **5**. At this time, the inlet **25***a* of the transfer pipe **25** of the station device **5** is connected to the connection part **39** of the dust container **12** of the autonomous collection device **2**. After that, the control part **93** of the station device **5** drives the secondary electric blower **69** to suck air in the direction of the arrow C included in FIGS. **4** and **5**A, and to move the object from the dust container **12** to the virus detection part **68**.

[Inside of Virus Detection Part]

Next, the inside of the virus detection part **68** will be described in detail with reference to FIG. **6**. FIG. **6** shows a schematic diagram of the internal structure of the virus detection part according to the first embodiment.

The virus detection part **68** comprises the detection part housing **102**, a separation part **105**, an analysis device **110**, and a determination part **111**.

The detection part housing **102** has a substantially rectangular parallelepiped shape. The detection part housing **102** contains the separation part **105**, the analysis device **110**, and the determination part **111**. The suction port **101** to which the outlet **25***c* of the transfer pipe **25** is connected is provided on the side surface of the detection part housing **102**. An opening to which the inlet **103***a* of the discharge pipe **103** is connected is provided on the top surface of the detection part housing **102**.

The separation part **105** extracts a virus from the object transferred through the transfer pipe **25**. Specifically, the separation part **105** comprises a cyclone part **106**, an extraction part **107**, an introduction pipe **108**, and a valve **109**.

The opening on the side surface of the cyclone part **106** is connected to the suction port **101**. The opening on the top surface of the cyclone part **106** is connected to the discharge pipe **103**. Therefore, when the secondary electric blower **69** is activated, the object is sucked into the cyclone part **106** together with air from the dust container **12** of the autonomous collection device **2**. The air and the object sucked into the cyclone part **106** are swirled in the cyclone part **106**. As a result, the air is discharged to the upper discharge pipe **103**, whereas the object falls to the extraction part **107**, which is located downward. In this way, the object is separated from the air using the centrifugal force in the cyclone part **106**. In place of using the secondary electric blower **69**, the primary electric blower **13** of the autonomous collection device **2** may be reversely rotated to send air to the dust container **12** and to discharge the object from the dust container **12** to the station device **5**.

The extraction part **107** extracts the virus from the object separated by the cyclone part **106** into an extraction liquid. The extraction part **107** is disposed below the cyclone part **106**. The extraction liquid for extracting the virus is supplied in advance to the extraction part **107**. The object separated by the cyclone part **106** falls into the extraction liquid in the extraction part **107**. Then, a virus is extracted from the object with the extraction liquid. In this way, a sample liquid containing the extraction liquid, the object, and the virus is prepared in the extraction part **107**.

The sample liquid is dropped onto the analysis device **110** through the introduction pipe **108**. The introduction pipe **108** is connected below the extraction part **107**.

The valve **109** is provided in the middle of the introduction pipe **108**. The dropping of the sample liquid is controlled by opening and closing the valve **109**.

The analysis device **110** analyzes the sample liquid. An example of the analysis device **110** is an immunochromatographic device. The virus is detected through a reaction that occurs in a liquid using the immunochromatographic device. Any sensor may be used as the analysis device **110**. For example, a sensor using surface plasmon-field enhanced fluorescence spectroscopy may be used as the analysis device **110**.

The determination part **111** determines the presence or absence of the virus on the basis of the analysis result provided using the analysis device **110**. Specifically, the determination part **111** comprises an image sensor **112**, a light emitting part **113**, and a controller **114** that controls the image sensor **112** and the light emitting part **113** and analyzes an image.

An example of the image sensor **112** is a solid-state imaging device such as a charge-coupled device (CCD) image sensor or a complementary metal-oxide semiconductor (CMOS) image sensor. An image of the analysis device **110** is captured using the image sensor **112**.

The light emitting part **113** is a light source for irradiating the analysis device **110** with light.

The controller **114** controls the light emitting part **113** and the image sensor **112** in such a way that the light emitting part **113** irradiates the analysis device **110** with light and that the image sensor **112** captures an image of the analysis device **110**. Further, the controller **114** analyzes the captured image. Specifically, the controller **114** determines the presence or absence of the virus by determining whether or not a red line is generated in the analysis device **110** on the basis of the image.

[Operation of Detection Device]

Next, the operation of the detection device **1** will be described with reference to FIG. **7** and FIG. **8**.

FIG. **7** is a flowchart of the operation of the detection device according to the first embodiment. FIG. **8** is a process diagram of the operation of the detection device according to the first embodiment. Hereinafter, with reference to FIG. **7** and FIG. **8**, the processing from the suction of the object from the floor surface by the autonomous collection device **2** to the virus analysis and determination by the station device **5** in the first embodiment will be described.

First, the autonomous collection device **2** autonomously moves the floor surface and disperses the dry adsorbent on the floor surface (S**101**). Specifically, the robot control part **17** controls the dry adsorbent dispersion means **52** to send air into the dry adsorbent container **51**, thereby discharging the dry adsorbent from the opening **51***a*. In place of using the dry adsorbent dispersion means **52**, the dry adsorbent may be dispersed using the primary electric blower **13**.

Next, the autonomous collection device **2** moves to the position where the dry adsorbent has been dispersed, and then sucks the object dried by the dry adsorbent (S**102**). Specifically, the robot control part **17** controls the primary electric blower **13** to generate the suction negative pressure. In this way, the object is sucked from the suction opening **36**, and then the object dried by the drying part **18** is stored in the dust container **12**.

Thereafter, the autonomous collection device **2** moves to the home position of the station device **5** (S**103**). As a result, the dust container **12** of the autonomous collection device **2** is fluidically connected to the transfer pipe **25** of the station device **5**.

The station device **5** transfers the object stored in the dust container **12** of the autonomous collection device **2** to the cyclone part **106** of the virus detection part **68** (S**104**). Specifically, the control part **93** of the station device **5** controls the secondary electric blower **69** to suck the object from the dust container **12**, thereby transferring the object together with air to the cyclone part **106** of the virus detection part **68**.

The virus detection part **68** detects the virus contained in the object transferred from the dust container **12** of the autonomous collection device **2** (S**105**). Hereinafter, detection of the virus will be described in detail with reference to FIG. **9** and FIG. **10**.

FIG. **9** is a flowchart of the operation of the virus detection part according to the first embodiment. FIG. **10** is a process diagram of the operation of the virus detection part according to the first embodiment.

The cyclone part **106** separates the sucked object from the air (S**201**).

Specifically, the cyclone part **106** separates the air and the object upward and downward, respectively, using centrifugal force generated by the suction of the secondary electric blower **69**. In place of using the cyclone part **106**, the object may be separated from the air through a filter.

The extraction part **107** extracts the virus from the separated object (S**202**). Specifically, the control part **93** stops the suction conducted by the secondary electric blower **69**. The object separated by the cyclone part **106** is mixed with the extraction liquid supplied in advance to the extraction part **107**. The virus is extracted from the mixture of the object and the extraction liquid.

The controller **114** drops the sample liquid onto the analysis device **110** (S**203**). Specifically, the controller **114** opens the valve **109** for a certain period of time to drop the sample liquid onto the analysis device **110**. Further, the controller **114** closes the valve **109** after the certain period of time, and then moves the region of the analysis device **110** onto which the sample liquid has been dropped to an imaging region. The virus in the dropped sample liquid reacts with a labeled antibody on the analysis device **110**. The labeled antibody is, for example, a colloidal gold labeled antibody.

The determination part **111** determines the presence or absence of the virus in the sample liquid (S**204**). Specifically, the controller **114** captures an image of the imaging region using the image sensor **112** and the light emitting part **113**. An antibody is immobilized on the imaging region. The immobilized antibody binds to the virus that has reacted with the labeled antibody. As a result, a red line appears on the analysis device **110**. Therefore, the controller **114** analyzes the captured image to determine whether or not the analysis device **110** has a red line. Here, if it is determined that the red line is present, the controller **114** determines that the sample liquid contains the virus. On the other hand, if it

is determined that the red line is absent, the controller **114** determines that the sample liquid does not contain the virus. Thereafter, the controller **114** presents the determination result to the lamp **81**. The virus detection part **68** may be included in the station device **5**; however, alternatively, the virus detection part **68** may be included in the autonomous collection device **2**. In this case, the autonomous collection device **2** can effectively collect the virus and detect the collected virus.

Summary of First Embodiment

As described above, the detection device **1** according to the first embodiment comprises the autonomous collection device **2** and the station device **5**. The autonomous collection device **2** autonomously moves on the floor surface and collects the object on the floor surface. The station device **5** detects the analyte from the object collected from the floor surface by the autonomous collection device **2**. The autonomous collection device **2** comprises the moving part **15** for moving on the floor surface, the primary electric blower **13** for sucking the object on the floor surface, and the dust container **12** for storing the sucked object. The station device **5** comprises the transfer pipe **25** which is fluidically connected to the dust container **12** of the autonomous collection device **2**, when the autonomous collection device **2** is located at the home position, and the virus detection part **68** for detecting the analyte from the object transferred from the dust container **12** through the transfer pipe **25**.

Such a detection device **1** collects the object on the floor surface and detects the analyte from the collected object. Many of the secretions, including pathogens such as a virus spread in air by coughing or sneezing, fall onto the floor surface. In the first embodiment, the object on the floor surface is collected, and then the analyte is detected from the collected object. In this way, the analyte is allowed to be detected effectively.

In the detection device **1** according to the first embodiment, the virus detection part **68** includes the cyclone part **106** for separating the object from the air using centrifugal force, and the extraction part **107** for extracting the analyte from the object separated by the cyclone part **106**.

Thereby, the analyte is allowed to be easily extracted from the object transferred with the air.

In the detection device **1** according to the first embodiment, the virus detection part **68** detects the analyte using the reaction that occurs in a liquid.

Thereby, the analyte is allowed to be detected using the liquid.

The station device **5** of the detection device **1** according to the first embodiment further comprises the lamp **81** for presenting a detection result provided by the virus detection part **68**.

Thereby, the detection result is allowed to be presented quickly to a user, and the spread of the virus infection is allowed to be suppressed.

The autonomous collection device **2** collects the analyte from the floor surface on which the object having the analyte and moisture is present. The autonomous collection device **2** comprises the drying part **18** for drying the object, the primary electric blower **13** for sucking the object dried by the drying part **18**, and the dust container **12** for storing the object sucked by the primary electric blower **13**.

Thereby, the object which is difficult to be sucked due to water contained therein is allowed to be dried and then sucked. Therefore, it is possible to improve the ability to collect the object including the analyte, and to collect the analyte effectively.

In the autonomous collection device **2**, the drying part **18** includes the dry adsorbent container **51** for storing the dry adsorbent for drying the object and the dry adsorbent dispersion means **52** for dispersing the dry adsorbent stored in the dry adsorbent container **51** on the floor surface.

Thereby, the dry adsorbent is allowed to be dispersed on the floor surface, and the object on the floor surface is allowed to be dried with the dry adsorbent and then sucked. Therefore, it is possible to improve the ability to collect the object including the analyte, and to collect the analyte effectively.

Second Embodiment

Hereinafter, the second embodiment will be described. The second embodiment is different from the first embodiment in that the amount of the object to be transferred from the autonomous collection device **2** to the station device is adjusted.

[Details of Station Device]

The station device will be specifically described with reference to FIG. **5**A and FIG. **11**. FIG. **11** is a vertical cross-sectional view of the station device **5**A according to the second embodiment.

As shown in FIG. **5**A, the station device **5**A according to the second embodiment comprises a control part **93**A in place of the control part **93**. Furthermore, as shown in FIG. **11**, the station device **5**A comprises a dust sensor **121**A in the middle of the transfer pipe **25**.

The dust sensor **121**A detects the object being transferred through the transfer pipe **25**. In the second embodiment, the dust sensor **121**A comprises a light emitting element **122**A for irradiating the inside of the transfer pipe **25** with light and a light receiving element **123**A provided so as to face the light emitting element **122**A. The light receiving element **123**A outputs an electric signal having a level corresponding to the amount of received light to the control part **93**A.

The control part **93**A is one example of an adjustment part for adjusting the amount of the object transferred from the dust container **12** to the virus detection part **68**. In the second embodiment, the control part **93**A detects a temporal change in the amount of the light received by the light receiving element **123**A that depends on the transfer amount of the object which passes between the light emitting element **122**A and the light receiving element **123**A on the basis of the electric signal input from the light receiving element **123**A to measure the transfer amount of the object in the transfer pipe **25**. The control part **93**A stops the operation of the secondary electric blower **69** to stop the suction of the object from the dust container **12**, when the measured transfer amount of the object exceeds a predetermined threshold amount. The predetermined threshold amount is determined based on the processing capability of the virus detection part **68**.

[Details of Transfer Process]

Next, the operation of the station device **5**A will be described. The basic operation of the station device **5**A is the same as the operation in the first embodiment (see FIG. **7**). Details of the object transfer process (S**104**) will be described below with reference to FIG. **12**.

FIG. **12** is a flowchart of a transfer process of the object in the second embodiment. Specifically, FIG. **12** shows details of the process of step S**104** in the second embodiment.

First, the control part **93**A measures the transfer amount of the object in the transfer pipe **25** based on the output signal output from the dust sensor **121**A (S**301**). The control part **93**A determines whether or not the measured transfer amount of the object is less than the threshold amount (S**302**).

If the transfer amount is equal to or greater than the threshold amount (No in S**302**), the control part **93**A stops the suction conducted by the secondary electric blower **69** to complete the transfer process of the object.

On the other hand, if the transfer amount is less than the threshold amount (Yes in S**302**), the control part **93**A determines whether or not the transfer is completed (S**303**). For example, the control part **93**A determines whether or not to complete the transfer on the basis of at least one selected from the group consisting of a transfer time and the input signal from the autonomous collection device **2**. For example, the control part **93**A may determine whether or not to complete the transfer on the basis of a comparison result between an elapsed time from the start of the suction by the secondary electric blower **69** and a predetermined threshold time. Alternatively, the control part **93**A may determine whether or not to complete the transfer on the basis of an input signal indicating that the dust container **12** is empty.

If it is determined that the transfer is not completed (No in S**303**), the control part **93**A continues the suction conducted by the secondary electric blower **69** (return to S**301**). On the other hand, if it is determined that the transfer is completed (Yes in S**303**), the control part **93**A stops the suction conducted by the secondary electric blower **69** to complete the transfer process of the object.

Summary of Second Embodiment

As described above, in the second embodiment, the station device **5**A comprises the control part **93**A for adjusting the amount of the object to be transferred from the dust container **12** to the virus detection part **68**.

Thereby, the station device **5**A does not have to transfer all the objects in the dust container **12** to the virus detection part **68**, and can transfer adjust an amount the object, depending on the capability of the virus detection part **68**. Therefore, the virus detection part **68** can detect the analyte more effectively.

In the second embodiment, the transfer amount of the object is measured by a photoelectric sensor such as the light receiving element **123**A. However, the transfer amount of the object may be measured by a method other than the method using the photoelectric sensor. For example, the transfer amount of the object may be measured by measuring a change in the weight of the virus detection part **68** using a weight sensor. In order to adjust the transfer amount, it is not necessarily needed to measure the transfer amount. For example, the transfer amount may be adjusted by controlling the transfer time. Specifically, for example, the secondary electric blower **69** may suck the object only for a predetermined time in a state where the object is sufficiently stored in the dust container **12**.

Third Embodiment

Hereinafter, the third embodiment will be described. The third embodiment is different from the first embodiment in that the movement of the autonomous collection device on the floor surface and the collection of the object on the floor surface are started, when a sound generated when a human released the analyte is detected. In the present specification, the sound generated when a human releases the analyte is referred to as a "released sound".

[Details of Autonomous Collection Device]

FIG. **13** shows a schematic diagram of an autonomous collection device **2**B in the third embodiment. The autonomous collection device **2**B comprises a microphone **131**B on the top surface of the main body case **11**.

The microphone **131**B converts sound into an electric signal. The microphone **131**B outputs the electric signal to a robot control part **17**B.

The robot control part **17**B processes the output signal of the microphone **131**B to detect a released sound generated when a human releases the virus. The released sound is, for example, a cough or sneeze sound. For example, the robot control part **17**B detects the released sound by analyzing the output signal of the microphone **131**B on the basis of the frequency thereof. The method for detecting the released sound is not limited.

When the robot control part **17**B detects the released sound, the robot control part **17**B controls the moving part **15** to start the movement of the autonomous collection device **2**B on the floor surface and the collection of the object on the floor surface. For example, when the robot control part **17**B detects the released sound in a state where the robot control part **17**B is located at the home position, the robot control part **17**B starts moving from the home position.

Summary of Third Embodiment

As described above, in the third embodiment, the autonomous collection device **2**B comprises the microphone **131**B for detecting the released sound generated when the human releases the analyte and the robot control part **17**B. When the robot control part **17**B detects the released sound through the microphone **131**B, the robot control part **17**B controls the moving part **15** to start the movement of the autonomous collection device **2**B on the floor surface and the collection of the object.

Thereby, when the coughing or sneezing sound is detected, the autonomous collection device **2**B starts the collection of the object. Therefore, after the secretion containing the analyte is scattered on the floor surface, the analyte is allowed to be quickly collected from the floor surface. In this way, the analyte can be detected more effectively.

The microphone **131**B may include a plurality of directional microphones each having directivity. In this case, the robot control part **17**B may detect a direction in which the released sound is generated by comparing the output signals of the plurality of the directional microphones. Then, the robot control part **17**B may move the autonomous collection device **2**B in the detected direction.

Fourth Embodiment

Hereinafter, the fourth embodiment will be described. The fourth embodiment is different from the first to third embodiments in that air is blown to the object on the floor surface in order to dry the object on the floor surface.

[Details of Autonomous Collection Device]

FIG. **14** shows a schematic view of a bottom surface of an autonomous collection device **2**C according to the fourth embodiment. As shown in FIG. **14**, the bottom surface **11***a* of the main body case **11** comprises the suction opening **36** and a blowing opening **141**C.

The blowing opening **141**C is one example of a first blowing part for drying the object by blowing air to the

object on the floor surface. The blowing opening **141**C doubles as an exhaust opening through which air sucked together with the object from the suction opening **36** is discharged. In other words, at least a part of the air sucked from the suction opening **36** is discharged from the blowing opening **141**C and is blown to the object on the floor surface. Thereby, the object on the floor surface is sucked from the suction opening **36** after dried.

Summary of Fourth Embodiment

As described above, in the fourth embodiment, the autonomous collection device **2**C is provided in front of the suction opening **36** for sucking the object. The autonomous collection device **2**C includes the blowing opening **141**C for drying the object by blowing air to the object on the floor surface.

In the autonomous collection device **2**C according to the fourth embodiment, air can be blown to the object on the floor surface to dry it, and then the object is sucked. Therefore, it is possible to improve the ability to collect the object including the analyte, and to collect the analyte effectively.

In the fourth embodiment, the blowing opening **141**C doubles as the exhaust opening through which the air sucked together with the object by the primary electric blower **13** is discharged.

Thereby, the object can be dried using the exhaust gas generated by the intake air for sucking the object. Therefore, it is not necessary to provide a dedicated electric blower for drying, and the configuration of the autonomous collection device **2**C can be simplified.

Fifth Embodiment

Hereinafter, the fifth embodiment will be described. The fifth embodiment is different from the first to fourth embodiments in that air is blown to the brush to dry the object attached to the brush.

[Details of Autonomous Collection Device]

FIG. **15** shows a schematic view of a bottom surface of an autonomous collection device **2**D in the fifth embodiment. FIG. **16** shows a cross-sectional view of the suction opening **36**, a blowing opening **151**D, and the vicinity thereof which are included in the autonomous collection device **2**D in the fifth embodiment.

As shown in FIG. **15** and FIG. **16**, a center brush **31** is provided in the vicinity of the suction opening **36** on the bottom surface **11***a* of the main body case **11**. In the fifth embodiment, the bottom surface **11***a* of the main body case **11** is provided with a recess part **152**D. A part of the center brush **31** is contained in the recess part **152**D. The suction opening **36** and the blowing opening **151**D are provided in the recess part **152**D.

The blowing opening **151**D is one example of a second blowing part for drying the object attached to the center brush **31** by blowing air on the center brush **31**. The blowing opening **151**D doubles as the exhaust opening through which air sucked together with the object from the suction opening **36** is discharged. In other words, at least a part of the air sucked from the suction opening **36** is discharged from the blowing opening **151**D and blown to the center brush **31**. As a result, the object attached to the center brush **31** is dried and then sucked from the suction opening **36**. In the fourth embodiment and the fifth embodiment, the blowing opening may be provided separately from the exhaust opening.

Summary of Fifth Embodiment

As described above, in the fifth embodiment, the autonomous collection device **2**D comprises the center brush **31** provided in the vicinity of the suction opening **36** through which the object is sucked and the blowing opening **151**D for drying the object attached to the center brush **31** by blowing air to the center brush **31**.

In the fifth embodiment, the object containing moisture attached to the center brush **31** can be dried. Therefore, the object attached to the center brush **31** can be easily sucked from the suction opening **36**, the ability to collect the object including the analyte can be improved, and the analyte can be effectively collected.

In the fifth embodiment, the blowing opening **151**D doubles as an exhaust opening through which the air sucked by the primary electric blower **13** together with the object is discharged.

Thereby, the object can be dried using the exhaust gas generated by the intake air for sucking the object. Therefore, it is not necessary to provide a dedicated electric blower for drying, and the configuration of the autonomous collection device **2**D can be simplified.

Sixth Embodiment

Hereinafter, the sixth embodiment will be described. In the sixth embodiment, the station device comprises a storage part for storing the object between the dust container of the autonomous collection device and the virus detection part.

FIG. **5**B shows a transverse cross-sectional view of a station device **5**E according to the sixth embodiment. The station device **5**E comprises a storage part **160**E, a virus detection part **68**E, and valves **161**E to **163**E. The storage part **160**E has a suction port **101**E to which the outlet **25***c* of the transfer pipe **25** is connected. The storage part **160**E is connected to the discharge pipe **103** through the valve **161**E. The storage part **160**E is connected to the virus detection part **68**E through the valve **163**E. The virus detection part **68**E is connected to the discharge pipe **103** through the valve **162**E. The control part **93** opens the valve **161**E, closes the valves **162**E and **163**E, and then operates the secondary electric blower **69** to transfer the object from the dust container **12** of the autonomous collection device **2** to the storage part **160**E. Thereafter, the control part **93** closes the valve **161**E, opens the valves **162**E and **163**E, and then operates the secondary electric blower **69** to transfer the object from the storage part **160**E to the virus detection part **68**E. In this way, the station device **5**E can temporarily store the object transferred from the autonomous collection device **2** in the storage part **160**E, and effectively detects the virus, depending on the processing capability of the virus detection part **68**E.

Others

Several embodiments of the present disclosure have been described above. These embodiments are presented as examples and are not intended to limit the scope of the invention. These novel embodiments are allowed to be implemented in various other forms. Various omissions, replacements, and changes can be made without departing from the scope of the invention. These embodiments and modifications thereof are included in the scope and gist of the invention, and are included in the invention described in the claims and the equivalents thereof.

INDUSTRIAL APPLICABILITY

In order to decrease the risk of the virus infection to people staying in the room, the present disclosure provides an autonomous collection device for collecting an object including moisture (e.g., saliva drained onto the floor surface due to coughing or sneezing).

REFERENTIAL SIGNS LIST

1 Detection device
2, **2**B, **2**C, **2**D Autonomous collection device
3 Charging electrode
5, **5**A, **5**E Station device
11 Main body case
11*a* Bottom surface
12 Dust container
13 Primary electric blower
15 Moving part
16 Drive part
17, **17**B Robot control part
18 Drying part
19 Secondary battery
21 Pedestal
22 Housing
25 Transfer pipe
25*a* Inlet
25*b* Seal member
25*c* Outlet
26 Lever
29 Power cord
31 Center brush
32 Center brush drive part
36 Suction opening
37 Dust container opening
38 Container Main body
39 Connection part
41 Disposal opening
42 Disposal lid
45 Pair of drive wheels
46 Turning wheel
47 Charging terminal
51 Dry adsorbent container
51*a* Opening
52 Dry adsorbent dispersion means
61 High floor surface part
62 Low floor surface part
68 Virus detection part
69 Secondary electric blower
71 Recess part
72 Detection part
73 First sensor part
75 Second sensor part
81 Lamp
82 Lid
85 Downstream pipe
93, **93**A Control part
95 Detection part chamber
96 Blower chamber
97 Hook
101, **101**E Suction port
102 Detection part housing
103 Discharge pipe
103*a* Inlet
103*b* Outlet
105 Separation part
106 Cyclone part
107 Extraction part
108 Introduction pipe
109, **161**E, **162**E, **163**E Valve
110 Analysis device
111 Determination part
112 Image sensor
113 Light emitting part
114 Controller
121A Dust sensor
131B Microphone
141C, **151**D Blowing opening
152D Recess part
160E Storage part

The invention claimed is:

1. A device, comprising:

a collection device for collecting an object having an analyte and moisture from a floor surface, the collection device comprising:

a drying part, wherein the drying part comprises a blower and a dry adsorbent container which is configured to store a dry adsorbent for drying the object, the drying part is configured to dry the object by blowing air into the dry adsorbent container to disperse the dry adsorbent, which has been stored in the dry absorbent container, on the floor surface, and the dry adsorbent dispersed on the floor surface absorbs the moisture to dry the object;

a suction part for sucking the object and the dry adsorbent, the object having been dried by the drying part, wherein the suction part comprises an electric blower; and

a storage part for storing the object sucked by the suction part, wherein the storage part comprises a dust container; and

a detection instrument for connecting fluidically to the collection device when the collection device moves to a predetermined position, for acquiring the object stored in the storage part, and for detecting the analyte from the acquired object, wherein the detection instrument comprises a transfer pipe connecting to the collection device and a substance detection part for detecting the analyte from the collected object, wherein the substance detection part comprises an image sensor, a light source, and a controller that controls the image sensor and the light source.

2. The device according to claim **1**, wherein

the collection device further comprises a brush provided in a vicinity of a suction opening for sucking the object; and

the drying part includes a second blowing part for drying the object attached to the brush by blowing air to the brush, wherein the second blowing part comprises a second blowing opening.

3. The device according to claim **2**, wherein

the second blowing part doubles as an exhaust part for discharging air sucked together with the object by the suction part.

4. The device according to claim **1**, wherein

the collection device further comprises a substance detection part for detecting the analyte from the collected object, wherein the substance detection part comprises an image sensor, a light source, and a controller that controls the image sensor and the light source.

5. The device according to claim **1**, wherein

the blower is an electric blower.

6. The device according to claim **1**, wherein the dry adsorbent is a polymer.

7. The device according to claim 1, wherein the dry adsorbent has a property of adsorbing the analyte.

8. A detection device, comprising:

a collection device for collecting an object having an analyte and moisture from a floor surface, the collection device comprising:

a drying part, wherein the drying part comprises a blower and a dry adsorbent container which is configured to store a dry adsorbent for drying the object, the drying part is configured to dry the object by blowing air into the dry adsorbent container to disperse the dry adsorbent, which has been stored in the dry absorbent container, on the floor surface, and the dry adsorbent dispersed on the floor surface absorbs the moisture to dry the object;

a suction part for sucking the object and the dry adsorbent, the object having been dried by the drying part, wherein the suction part comprises an electric blower; and

a storage part for storing the object sucked by the suction part, wherein the storage part comprises a dust container; and

a detection instrument for connecting fluidically to the collection device when the collection device moves to a predetermined position, for acquiring the object stored in the storage part, and for detecting the analyte from the acquired object, wherein the detection instrument comprises a transfer pipe connecting to the collection device and a substance detection part for detecting the analyte from the collected object, wherein the substance detection part comprises an image sensor, and a controller that controls the image sensor.

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